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NATIONAL DAM INSPECTION PROGRAM. LAKE SUSQUEHANNA DAM, NDS ID N--ETC(U)
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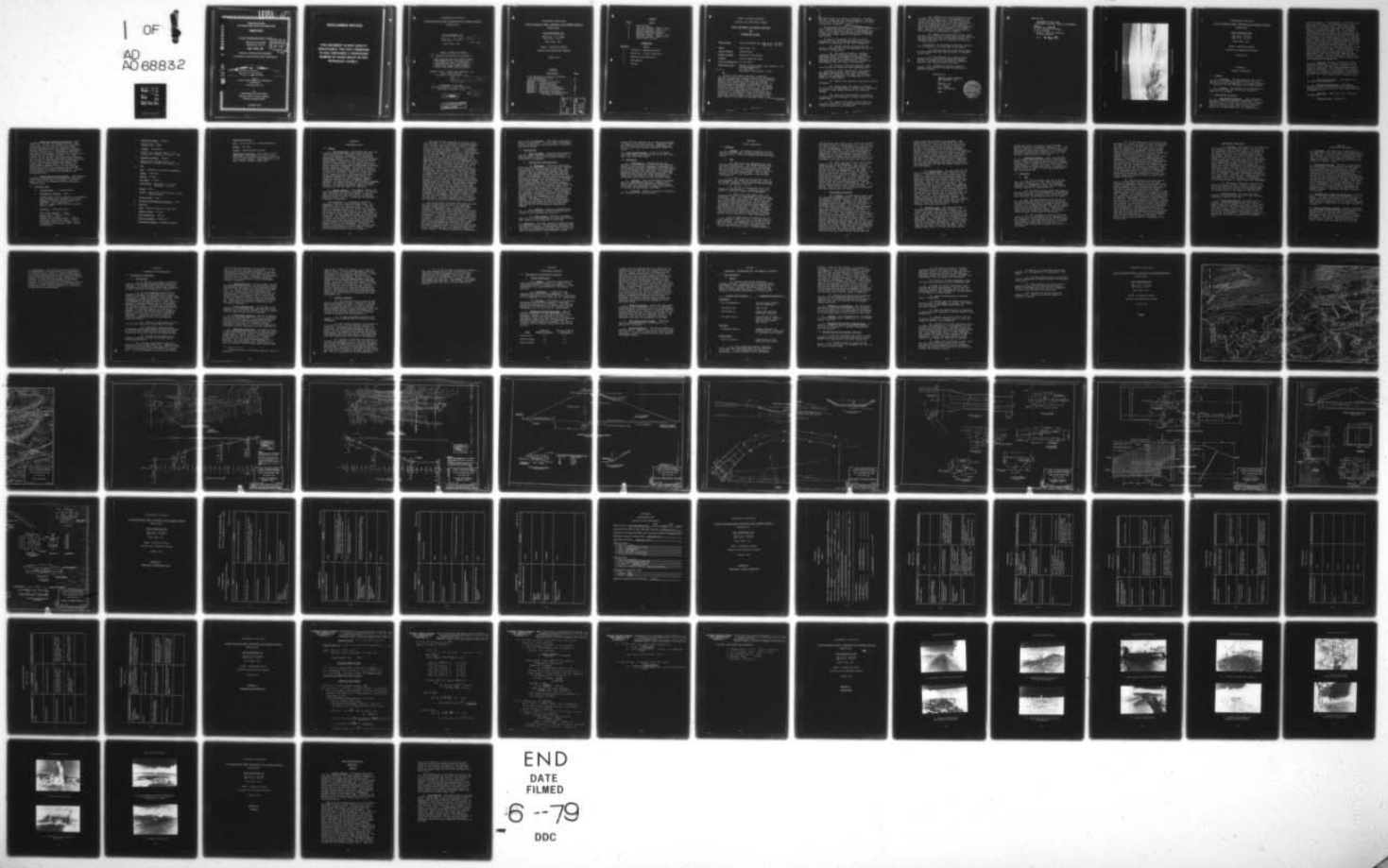

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SUSQUEHANNA RIVER BASIN
LITTLE SUGARLOAF CREEK, SCHUYLKILL AND LUZERNE COUNTIES

PENNSYLVANIA

LAKE SUSQUEHANNA DAM

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NDS ID NO. PA-00818
DER ID NO. 54-177

HIGH VISTA, INC.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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Contract No. DACW31-78-C-0046

Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

AUGUST 1978

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SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL AND LUZERNE COUNTIES

PENNSYLVANIA

LAKE SUSQUEHANNA DAM

NDS ID No. PA - 00818
DER ID No. 54-177

HIGH VISTA, INC.

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PHASE I INSPECTION REPORT

(6) NATIONAL DAM INSPECTION PROGRAM.

Lake Susquehanna Dam, NDS ID Number PA-00818 DER ID Number 54-177. High Vista, Inc., Susquehanna River Basin, Little Sugarloaf Creek, Schuylkill and Luzerne Counties, Pennsylvania, Phase I Inspection Report.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

(15) For DACW31-78-C-0046

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL AND LUZERNE COUNTIES

PENNSYLVANIA

LAKE SUSQUEHANNA DAM

NDS ID No. PA - 00818
DER ID No. 54-177

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Lake Susquehanna Dam (NDS ID No. PA-00818; DER ID No. 54-177)
Owner:	High Vista, Inc.
State Located:	Pennsylvania
County Located:	Schuylkill and Luzerne
Stream:	Little Sugarloaf Creek
Date of Inspection:	26 June 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on the visual inspection, available records, calculations and past operational performance, Lake Susquehanna Dam is judged to be in good condition. However, the spillway will not pass the Probable Maximum Flood (PMF) without overtopping the dam. If Lake Susquehanna Dam should be overtopped, it would probably fail by embankment erosion. If Lake Susquehanna Dam should fail due to overtopping, the hazard to loss of life downstream from the dam would be significantly increased from that which would exist just prior to overtopping. Based on criteria established for theses studies by the Department of the Army, Office of the Chief of Engineers (OCE), the

spillway capacity is rated as inadequate. One-half the PMF is less than the spillway capacity; therefore, based on the OCE criteria, the spillway is not rated as seriously inadequate.

The existing spillway can accommodate a flood with a peak inflow of 56 percent of the PMF peak flow. If the low area of the top of embankment were brought up to grade, the spillway would accommodate a flood with a peak inflow of 66 percent of the PMF peak inflow.

In view of the concern for safety of Lake Susquehanna Dam, the following measures are recommended to be undertaken by the Owner immediately:

(1) Perform surveys to establish the extent of the low area on the embankment and fill in the area to design grade.

(2) Fill gaps in riprap in spillway discharge channel with derrick stone. Perform additional study to determine the adequacy of the gradation and extent of riprap in the spillway discharge channel and outlet channel, and make any improvements that are found to be necessary.

(3) Develop a detailed emergency operation and warning system for Lake Susquehanna Dam.

In order to correct operational, maintenance and repair deficiencies, and to more accurately determine the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Remove brush growing on upstream slope of embankment.

(2) Either limit the travel of vehicles on the top of the embankment to amounts that vegetation can bear or make proper provisions for vehicular traffic.

(3) Make such modifications as necessary to ensure positive drainage of surface runoff in the swampy area.

(4) Measure and record outflow from the toe drain outlets on a frequent basis so that any change in quantity can be detected.

(5) Install two or more observation wells or other instrumentation in the embankment in the vicinity of the swampy area. The wells should be placed downstream from the cutoff and should extend into the clayey gravel strata in the foundation. One or more additional wells or other instrumentation should be located in the remainder of the embankment. Monitor and keep records of water levels so that any change in conditions is apparent.

(6) Remove the accumulation of mud, sand, and fine gravel from the outlet works outlet structure and make operating tests to determine whether the materials have come from the reservoir or from the toe drain outlets.

In addition, the following operational measures are recommended to be undertaken by the Owner:

(1) Provide round-the-clock surveillance of Lake Susquehanna Dam during periods of unusually heavy rains.

(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

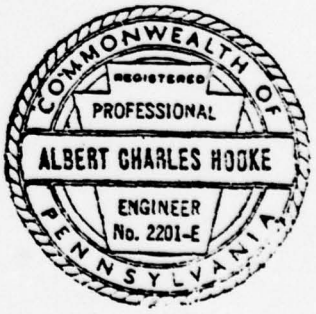
(3) Implement an annual inspection program of all project features and maintain inspection records.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

Date:



Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

Date: 8 Sep 78

LAKE SUSQUEHANNA DAM

Embankment and Outlet Channel

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL AND LUZERNE COUNTIES

PENNSYLVANIA

LAKE SUSQUEHANNA DAM

NDS ID No. PA-00818
DER ID No. 54-177

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Lake Susquehanna Dam is a homogeneous earthfill embankment. The embankment has a cutoff trench with a 10-foot bottom width at the axis of dam, and a 2-foot thick sand and gravel blanket drain under the downstream quarter of the embankment that is connected to a

gravel toe drain. The embankment is 1,800 feet long and is 50 feet high. The upstream slope of the embankment is riprapped from 3 feet below normal pool level to the top of dam, and the downstream slope is covered with crownvetch. The spillway is located at the left abutment. It is a concrete chute spillway with an ogee crest 45 feet long. At the end of the concrete chute, the discharge channel is riprapped for a distance of 80 feet. At the end of the riprap, the outlet channel, which is unlined, makes a sharp bend to the right and roughly parallels the toe of the dam until it makes a bend to the left and follows the natural stream channel. The outlet works is located about 600 feet from the left abutment and consists of a submerged concrete intake structure with a slide gate, a 36-inch diameter outlet conduit (RCP), and an outlet structure. The gate stem parallels the upstream slope of the embankment to the top of the dam, where the gate stand is located. Various features of the dam are shown on the Plates at the end of this report and on the Photographs in Appendix D.

b. Location. The dam is located on Little Sugarloaf Creek about 1.5 miles upstream from its confluence with Tomhicken Creek. Because it was recently constructed, Lake Susquehanna Dam does not appear on USGS Maps. It is located about 5 miles southwest of Conyngham, Pennsylvania, in Schuylkill and Luzerne Counties with coordinates N 40° 56'00" - W 76° 07' 30". The location map is shown on Plate 1.

c. Size Classification. Intermediate (50 feet high, 895 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Lake Susquehanna Dam (Paragraph 5.1e.).

e. Ownership. High Vista, Inc., Hazleton, Pennsylvania.

f. Purpose of Dam. Recreation.

g. Design and Construction History. Lake Susquehanna Dam was constructed in 1973 by High Vista, Inc., as part of a second home real estate development project known as Valley of Lakes. Initial engineering work was performed by Spotts, Stevens and McCoy, Inc., Wyomissing, Pennsylvania, and their subcontractor, Geo-Technical Services, Harrisburg, Pennsylvania. However, as a result of a dispute, Spotts, Stevens and McCoy, Inc. were relieved of the project, and the plans and specifications for the dam were prepared by Ebeco Associates, Inc., Hazleton, Pennsylvania, and their subcontractor, Northeastern Engineering Company, Inc., Clarks Summit, Pennsylvania. The project was operationally complete in 1973, but by 1976 the downstream slope of the embankment had suffered erosion damage and repairs were necessary. As part of the repairs, crownvetch was planted on the downstream slope.

h. Normal Operational Procedure. The reservoir is normally maintained at spillway crest level with excess water going over the spillway. The slide gate located at the submerged intake structure is normally closed.

1.3 Pertinent Data.

a. Drainage Area. 1.9 square miles.

b. Discharge at Damsite. (cfs.)

Maximum known flood at damsite - 150 (approximate discharge for September 1975 flood).
Emergency drawdown line at maximum pool elevation - 170 (approximate).
Spillway capacity with pool at Elevation 1195.4 - 2290.

c. Elevation. (Feet above msl.)

Top of dam (design) - 1196.0.
Top of dam (low spot) - 1195.4.
Maximum pool - 1195.4.
Normal pool (spillway crest) - 1190.0.
Upstream invert outlet works - 1146.0.
Downstream invert outlet works - 1145.0.
Streambed at centerline of dam - 1140.0 (approximate).

d. Reservoir Length. (Miles.)

Normal pool - 0.39.
Maximum pool - 0.40.

e. Storage. (Acre-feet.)

Normal pool (spillway crest) - 614.
Maximum pool (design top of dam) - 895.

f. Reservoir Surface. (Acres.)

Normal pool (spillway crest) - 44.
Maximum pool (design top of dam) - 50.

g. Dam.

Type - Homogeneous earthfill embankment.

Length - 1800 feet.

Height - 50 feet.

Top Width - 20 feet.

Side Slopes - Downstream - 1V on 2H.
Upstream - 1V on 3H.

Zoning - None.

Cutoff - Earthfilled cutoff trench 10 feet wide at bottom.

Grout Curtain - None.

h. Diversion and Regulating Tunnels. None.

i. Spillway.

Type - Concrete chute with ogee weir.

Length of Weir - 45 feet.

Crest Elevation - 1190.0.

Upstream Channel - Reservoir.

Downstream Channel - Riprapped channel.

j. Regulating Outlets.

Type - One 36-inch RCP through embankment.

Length - 240 feet.

Access - From downstream outlet.

Regulating Facilities - One 3-foot x 3-foot slide gate. Gate stand is at top of dam. Stem is 2-inch diameter stainless steel 5 TPI in oil-filled casing. Crank operated, 3 to 1 gear reducer, exposed rising stem.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Engineering data that was available for review included a report entitled "Soil Investigation, Susquehanna Dam, Big Valley Recreation Development" prepared by Northeastern Engineering Company, Inc., Consulting Soils Engineers, Clarks Summit, Pennsylvania; the project plans and specifications prepared by Ebeco Associates, Inc., Hazleton, Pennsylvania; and the permit application report prepared by Pennsylvania Department of Environmental Resources (PennDER). The report by Northeastern Engineering Company contains the following design data: geologic information; boring and test pit logs; soil profiles; results of direct shear tests, compaction tests, and gradation analyses; recommended embankment designs and results of stability analyses for those designs; suggested compaction specifications; recommended filter gradation; a seepage estimate; and estimated shrinkage factors. The permit application report by PennDER specifies the minimum discharge capacity of the spillway as 2,250 cfs (Curve "C" criteria).

b. Design Features. The primary features of Lake Susquehanna Dam are the embankment, the concrete chute spillway, and the outlet works. A general plan and a profile along the axis of the dam are shown on Plates 2 and 3. A discussion on geology is presented in Appendix E.

The embankment is a homogeneous earthfill structure 1,800 feet long and 50 feet high. The embankment section is shown on Plate 4. The top width is 20 feet, the upstream slope is 1V or 3H, and the downstream slope is 1V on 2H. The upstream slope has 18-inch thick riprap on a 12-inch thick bed of gravel from 3 feet below normal pool level to top of dam, and the downstream slope is covered with crownvetch. An earthfilled cutoff trench, which has a 10-foot bottom width, is at the axis of the dam. A 2-foot thick sand and gravel filter blanket is located between the earth foundation and the downstream quarter of the embankment. The filter blanket is connected to a gravel toe drain that has a 6-inch perforated pipe in its center. The toe drain has three outlets along its length.

The concrete chute spillway is located at the left abutment. It is comprised of concrete approach walls, an ogee weir with a crest length of 45 feet, and a 135-foot long concrete chute. The spillway plan and profile are shown on Plate 5. The spillway details are shown on Plates 6 and 7. The spillway is shown on Photographs E, F, G and H. The centerline of the spillway makes a 45 degree angle with the axis of the dam. The approach channel walls are cantilever-type walls with a maximum height of 12 feet and have short cutoff walls extending into the embankment on the right and into the abutment on the left. The depth of approach at the weir is 3 feet. The concrete chute is 45 feet wide from the end of the weir to a point 15 feet downstream, and it narrows to 30 feet wide at a point 30 feet farther downstream. The concrete chute consists of L-Walls on each side with a center slab. The L-Walls vary in height from 6 feet to 11.8 feet and have a stem thickness of 1 foot. The base of the L-Wall is 1.5 feet thick, and the center slab is 0.67 foot thick. At the end of the chute, the discharge channel slope changes to about 1V on 4H. This section is about 80 feet long and is riprapped. The spillway discharge channel then joins an outlet channel from a mine tunnel that is located on the left hillside downstream from the dam. The centerline of the spillway discharge channel and the outlet channel are aligned such that the deflection angle between them is about 70 degrees to the right. The outlet channel is unlined and is approximately parallel to the toe of the dam until it reaches the center of the valley. At that point, the outlet channel curves to the left and follows the natural stream channel downstream.

The outlet works is located about 600 feet from the left abutment and consists of a submerged concrete intake structure, a 36-inch RCP conduit through the embankment, and a concrete outlet structure. A 36-inch square slide gate is installed at the intake structure and is operated from a gate stand on top of the dam. The gate stand is shown on Photograph L. Details of the outlet works are shown on Plate 8. The intake structure is equipped with a trashrack. The 36-inch diameter conduit is 240 feet long and is supported on a concrete cradle; there are 9 concrete seepage collars along its length. The stem of the slide gate, which is parallel to the upstream embankment slope, is stainless steel and is in an oil-filled casing. The stem has supports on 8-foot centers. The outlet structure is located at

the toe of the embankment. The outlet structure is shown on Photograph M. A short reach of riprapped channel connects the outlet structure to the spillway outlet channel.

2.2 Construction.

a. Data Available. Construction data available for review included the project plans and specifications, construction progress reports, and construction photographs.

b. Construction Considerations.

(1) Embankment. Review of the project plans and specifications did not yield any concerns with respect to the character of the work. The progress reports filed by the Resident Engineer indicate that the embankment materials were compacted to the density required by the specifications. The embankment section shown on the plans is the same section that was designed by Northeastern Engineering Company with two exceptions. A 2-foot thick filter blanket was used instead of the 1.5-foot recommended thickness, and the recommended riprap protection for the upstream slope, which was 18 inches of riprap on 12 inches of stone on 6 inches of sand, was changed to 18 inches of riprap on 12 inches of filter material. These changes do not represent significant deviations from design. The gradation of material specified for the filter blanket under the embankment is the same as the gradation designed by Northeastern Engineering Company. The gradation of the filter material proposed for use under the riprap varied slightly from the specifications, but it was tested and approved for use by Northeastern Engineering Company.

(2) Spillway. Review of available data for the spillway did not yield any concerns with respect to the character of that work.

(3) Outlet Works. Review of available data for the outlet works did not yield any concerns with respect to the character of that work.

2.3 Operation. No formal records of operation were available for review. Correspondence indicates that the dam was inspected by Commonwealth authorities in 1976 and that recommendations were made to fill and seed erosion gullies on the embankment, remove

debris from the spillway, and to complete placement of riprap in the outlet channel. Apparently, work was undertaken for the first two recommendations, but it is not known whether additional riprap was placed.

2.4 Other Investigations. As far as is known, there have been no investigations of the dam other than those described herein.

2.5 Evaluation.

a. Availability. Engineering data was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania, and by the Owner, High Vista, Inc. The Owner made available personnel for information and operating demonstrations during the visual inspection. The Owner also researched his files for additional information upon request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data, together with visual inspection and computations performed for this study, are sufficient to assess the condition of the dam and appurtenant structures.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The general appearance of this project indicated that the project features are in good condition. Specific observations are described herein.

b. Dam.

(1) The top of the embankment has some vertical irregularities. The design elevation for top of dam is Elevation 1196.0, but a survey made for this inspection indicated elevations varying from Elevation 1197.5 to Elevation 1195.4, which is 0.6 foot lower than design level. The low area occurs in a short reach adjacent to the spillway (Photograph G).

(2) The riprap on the upstream slope of the embankment was intact and continuous to the top of the dam. However, small brush was growing among the stone (Photographs A and B).

(3) The top of the dam had very little vegetation (Photograph A). Apparently, this is a result of vehicular traffic on the embankment.

(4) Except for a few small areas, the downstream slope of the embankment was covered with crownvetch, grass, and clover ranging from 12 inches to 30 inches high (Photograph C). Those areas not yet covered with vegetation will soon be covered. Some minor sloughing and gullying were observed, but it appeared that it had occurred before vegetation had become fully established. A typical sloughed area is shown on Photograph D. Anti-erosion boards that were installed about mid-height on the downstream slope in conjunction with repair of erosion gullies in 1976 are still in place (Photograph D).

(5) A swampy area is located at the toe of the embankment from 400 feet to 500 feet from the right abutment. The swampy area is bounded by the right hillside, the embankment, and an access road. The area is drained by a 15-inch diameter pipe culvert under the access road. A slight amount of

standing water was visible, but no flow was observed, and the area was not excessively soft. One of the toe drain outlets, a 6-inch BCCMP, discharges at the toe of the embankment in this area, and the flow travels overland about 15 feet before entering the pipe culvert under the access road (Photograph J). Examination of the surroundings indicates that the swampy area is probably due to a combination of concentration of surface runoff and lack of positive drainage to the pipe culvert under the access road.

(6) Three toe drain outlets were visible along the toe of the embankment. One, a 6-inch BCCMP located 400 feet from the right abutment, is described above. It had a clear flow of about 10 gallons per minute (Photograph J). Two other outlets, both 8-inch BCCMP, entered the sides of the outlet structure of the outlet works. The one entering the right side had a slight trickle of clear flow (Photograph K). It had a 1½-inch thick accumulation of sandy clay along its length, and about ½ cubic yard of sand and fine gravel were located near its outlet (Photograph K). The toe drain outlet entering the left side was dry, and it had no accumulation of soil along its length. However, about ½ cubic yard of sand and fine gravel was also located near its outlet.

c. Appurtenant Structures.

(1) Spillway. No deficiencies were noted for the concrete chute spillway. The concrete was in excellent condition and all joints were sealed (Photographs E and F). However, the spillway discharge channel was apparently not constructed in accordance with the plans. The riprap in the discharge channel extends about 80 feet downstream on a 1V an 4H slope (Photograph H), whereas the plans show riprap for a distance of 125 feet. In addition, the riprap was not grouted in place as shown on the plans. The placement of the riprap was not uniform and occasional gaps were visible. The size of the stone ranges from about 12-inch stone to derrick size stone. It did not appear that a specific gradation had been used. At the end of the riprap, the channel makes a sharp bend to the right. This unlined outlet channel then runs approximately parallel to the toe of the dam until it reaches the center of the valley, where it then curves to the left and follows the natural stream channel. A profile along the outlet channel showed that the

actual grade varied from the design grade. The design grade line and the actual grade line are shown on Plate 5. Flow from a mine tunnel located on the left hillside enters the outlet channel at the end of the riprap in the spillway discharge channel. An estimated flow of 100-200 gallons per minute was flowing from the mine tunnel. An abandoned V-notch weir was located about 10 feet downstream from the tunnel opening, and the Owner said that it had been monitored by Commonwealth authorities in the past. The Owner said that a plan to neutralize the acid mine drainage by constructing a limestone fill in the outlet channel was being considered by the Commonwealth, but that the present status of the plan was unknown.

(2) Outlet Works. The gate stand at the top of the embankment was in good condition (Photograph L). The 36-inch RCP outlet conduit and the outlet structure were in good condition except for some fine cracking that extended outward from an expansion joint where the conduit enters the outlet structure. About 3 cubic yards of mud, sand, and fine gravel were in the outlet structure. The intake structure and the slide gate were submerged and could not be inspected. However, the gate was opened easily to about 1/3 full opening (Photograph M). The Owner said that the gate is partially opened every six months, and, at the same time, the oil level in the stem casing is checked to ensure that it is full. After operating the gate, it sealed tightly with no significant leakage. The discharge channel from the outlet works is riprapped with 12-inch stone from the outlet structure to where it joins the spillway outlet channel. No evidence of erosion was visible.

d. Reservoir Area. The slopes adjacent to the reservoir are covered with hardwoods. No evidence of creep, rock slides, or land slides was noted. The Owner indicated that sedimentation is not a problem from the standpoint of reduced reservoir capacity. The watershed is entirely owned by High Vista, Inc., and much of it is planned to be developed. However, High Vista has restrictions on cutting trees during development. The only trees that can be removed are those that must be cut in order to construct a house and driveway. Lake Calument Dam, which is a small dam that does not

impound any water, is located a short distance upstream from Lake Susquehanna (Photograph N). This dam was apparently constructed without a permit and Commonwealth authorities ordered it to be breached. The Owner indicated that tentative plans call for eventual rehabilitation of this dam.

e. Downstream Channel. Where the spillway outlet channel ends and the natural stream channel begins, there is an access road across the channel. A 6-foot diameter BCCMP culvert is under the roadway (Photograph 0). Beyond the culvert, the stream flows through the wooded area until it reaches Lake Choctaw, which is about 0.1 mile downstream from Lake Susquehanna Dam.

3.2 Evaluation.

a. Dam.

(1) The low area on the top of the dam near the spillway is 0.6 foot lower than design elevation. Consequently, this is the limiting elevation for maximum pool level, and the maximum spillway capacity is controlled by it.

(2) The brush growing among the riprap on the upstream slope of the embankment is undesirable. The Owner said that removal of the brush had already been scheduled as maintenance work for the summer.

(3) Driving vehicles across the top of the embankment has resulted in loss of vegetation. The top of embankment was not designed for as much traffic as it is apparently getting. Without proper provision for vehicular traffic, rutting and uneven crest levels will probably result. The loss of vegetation also reduces the ability of the dam to resist erosion in the event of overtopping.

(4) The sloughing and erosion that was observed is minor and repairs to the embankment are not warranted. The downstream slope of the embankment appears to have been stabilized by the vegetal cover that was established in 1976, and it is unlikely that erosion and sloughing will occur in the future.

(5) If the swampy area at the toe of the embankment is caused by surface runoff concentration and lack of positive drainage, it does not present any great hazard to the dam except that it would mask the development of any uncontrolled seepage under or through the embankment. Review of the investigations performed by Northeastern Engineering Company indicates that there is potential for seepage in this area because a clayey gravel strata underlies the foundation. The seepage estimate prepared by Northeasten Engineering Company ranged from 2,500 to 75,000 gallons per day, depending on the effectiveness of the cutoff and impervious material that was recommended to be placed upstream. The flow from the toe drain was estimated in this inspection to be about 10 gallons per minute, which is 14,400 gallons per day. Because of the conditions described herein, attention to the area is warranted to accurately determine the actual cause of the swampy area and to be able to detect any change in character.

(6) The flow from the toe drain outlet that is located about 400 feet from the right abutment is expected because of the geologic conditions described above. The flow was clear, and the outflow appears to be satisfactorily controlled. The lack of significant flow from the outlets located in the outlet works outlet structure is also expected because the foundation is primarily a sandy clay. However, the accumulation of sandy clay along the length of the right outlet and the accumulation of sand and fine gravels in front of both outlets is of interest. Two explanations are possible. Either some migration of fine materials and filter materials has occurred, or the material has been sucked from the reservoir bottom during the course of operation of the slide gate. During the gate operation for this inspection, it was observed that the water level in the outlet structure rose to such an extent that some flow occurred from the outlet structure into the toe drain outlets. It was also observed that the water from the conduit was muddy. In either case, no great concern is warranted at the present time.

b. Appurtenant Structures.

(1) Spillway. The reasons for the departures from design for the riprapped portion of the spillway discharge channel are not known. The nature of the departures are such that progressive erosion of the steep slope might occur during large spillway discharges. However, the area is located 120 feet downstream from the dam, and it is more likely that damage to the spillway chute would occur than damage to the embankment. With the exception of obvious deficiencies such as gaps and some stone that is too small, the overall adequacy of the extent and gradation of the riprap cannot be determined without additional study. As shown on Plate 5, the grade of the unlined portion of the outlet channel is lower than the design grade. This change was apparently made to accomodate the grade requirements imposed by the outlet works. However, this change has resulted in a deeper and steeper channel. Consequently, additional study is also necessary to determine if the existing channel is stable under high discharges.

(2) Nothing was observed in the outlet works that caused concern. However, removal of the present accumulation of mud, silt and gravel from the outlet structure and some testing would allow the determination of the source of the material.

c. Reservoir Area. No conditions were observed in the reservoir area that might present significant hazard to the dam.

d. Downstream Channel. No conditions were observed in the downstream channel that might present significant hazard to the dam. The culvert under the access road downstream from the dam is a flow restriction. However, the position of it and the type of construction are such that it would be washed away before raising the tailwater level to the toe of the embankment. Additional discussion of downstream conditions is presented in Paragraph 5.1e.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest level with excess inflow passing over the ogee weir. A 36-inch RCP outlet conduit, which has an intake structure with a trashrack and slide gate, can be used to draw down the reservoir or to augment streamflow. The slide gate on this outlet conduit is normally closed.

4.2 Maintenance of Dam. The dam is visited daily by the Assistant for Construction and Maintenance, who is responsible for maintenance of the Lake Susquehanna Dam and Lake Choctaw Dam, which is located downstream from Lake Susquehanna Dam. The Assistant for Construction and Maintenance is responsible for observing the general condition of the dam and appurtenant structures and for determining the need for maintenance. Formal inspections of the dam are not conducted by the Owner. The cover on the downstream slope of the embankment is crownvetch; consequently, no mowing is necessary. The brush and weeds on the upstream slope among the riprap are cut or sprayed with an herbicide when deemed necessary. Flow from toe drain outlets is not measured.

4.3 Maintenance of Operating Facilities. The slide gate on the outlet conduit is operated every six months. The Owner has records of when the gate was opened and the length of time that it was open. When the gate is operated, the oil level in the gate stem casing is checked and, if necessary, brought up to full.

4.4 Warning Systems in Effect. There is no formal warning system established for Lake Susquehanna Dam. During periods of heavy rainfall, the Project Engineer and the Assistant for Construction and Maintenance check the dam and inspect the spillway for debris. The Project Engineer said that if a problem were to develop, the slide gate on the outlet conduit would be opened at his direction.

4.5 Evaluation. The operational and maintenance procedures for the outlet works and the dam appear to be satisfactory. However, formal inspections of the dam and appurtenant structures should be made at least annually and records of the inspections should be kept. In addition, measurements of discharge from the toe drain outlets should be made on a frequent basis, and records of the discharges should be kept. A formal warning procedure for the downstream areas that would be affected by a failure of the dam should be established.

SECTION 5

HYDROLOGY AND HYDRALILICS

5.1 Evaluation of Features.

a. Design Data.

(1) No detailed hydrologic or hydraulic analyses for the Lake Susquehanna Dam design were reviewed. The PennDER permit application report indicated that the spillway capacity was sufficient to meet the Curve "C" discharge of 2,250 cfs.

(2) In the recommended guidelines for inspection of dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended spillway design flood for the size (intermediate) and hazard potential (high) classification of Lake Susquehanna Dam is the Probable Maximum Flood (PMF). If the dam and spillway are not capable of passing the PMF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, the spillway is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

(3) The Lake Susquehanna watershed is completely owned by High Vista, Inc. Large portions of the area are currently undeveloped, but it is the intent of the Owner to sell the land for building lots. The sales agreement for each parcel limits

the tree and shrub removal to that which is necessary to construct the house and driveway. It is expected that the planned development of the Lake Susquehanna watershed will not substantially alter the character of runoff. Therefore, the hydrologic analysis for this study was based on existing conditions and the effects of future development were not considered.

b. Experience Data. For this study, the PMF was obtained from the curve of PMF peak flow versus drainage area for Region 2 of the Susquehanna River Basin.[1] The PMF peak was estimated to be 5,080 cfs. The volume of the inflow hydrograph was adjusted to approximately 24 inches of runoff from the watershed. Calculations made for this study showed the spillway capacity to be 2,290 cfs with the pool at Elevation 1195.4, which is the maximum pool level based on the lowest elevation of top of dam. Hydrologic and hydraulic computations are included in Appendix C.

c. Visual Observations. On the date of the inspection, no conditions were observed that would indicate that the spillway capacity would be significantly reduced during a flood occurrence.

d. Overtopping Potential. For an occurrence of the PMF, the peak inflow of 5,080 cfs is greater than the spillway capacity of Lake Susquehanna Dam. A check of the surcharge storage effect of Lake Susquehanna shows that the surcharge storage available is insufficient to contain the PMF inflow hydrograph without overtopping the dam (Appendix C).

e. Downstream Conditions. As shown on Plate 1, Lake Susquehanna Dam is on Little Sugarloaf Creek in East Union Township, Schuylkill County and Black Creek Township, Luzerne County. Immediately downstream from the dam is Lake Choctaw. Planned developement in this area includes lake front property. The Lake Choctaw Dam embankment is 0.4 mile below Lake Susquehanna Dam. High Vista, Inc., plans to construct another dam downstream from Lake

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[1] Obtained from the Baltimore District, Corps of Engineers.

Choctaw Dam, which will complete their Valley of Lakes project. The planned development will be similar to the two existing lake projects. Future development of low-lying second homesites is expected to be considerable. About 1.7 miles downstream from Lake Susquehanna Dam is the confluence of Little Sugarloaf Creek with Tomhicken Creek. There are a few low-lying houses 0.7 mile downstream from this confluence. For the next 2.9 miles, Tomhicken Creek flows through a deeply incised valley that is a mixture of agricultural land and woodland with a few scattered low-lying houses. The downstream conditions indicate that a high hazard classification is warranted for Lake Susquehanna Dam.

f. Spillway Adequacy.

(1) The spillway will not pass the PMF without overtopping the dam. One-half of the PMF has a peak inflow of 2,540 cfs, which is greater than the spillway capacity. A check of the surcharge storage effect of Lake Susquehanna shows that the surcharge storage available is sufficient to contain an inflow with a peak flow of 2,540 cfs without overtopping the dam (Appendix C).

(2) If Lake Susquehanna Dam were overtopped, it would probably fail by erosion of the embankment.

(3) The maximum tailwater is estimated to be Elevation 1143.1 at the spillway capacity of 2,290 cfs. At maximum pool elevation, there is a difference of 52 feet between headwater and tailwater. If Lake Susquehanna Dam should fail due to overtopping, the hazard to loss of life downstream from the dam would be significantly increased from that which would exist just prior to overtopping.

(4) Based on established OCE criteria as outlined in Paragraph 5.1a.(2), the spillway capacity of Lake Susquehanna Dam is rated as inadequate. Considering the effects of the surcharge storage of 251 Acre-feet, the spillway discharge capacity of 2,290 cfs can accommodate a flood with a peak inflow of 2,820 cfs for a storm of the same duration as the PMF. This is 56 percent of the PMF peak inflow.

(5) If the low area of the top of embankment were brought up to grade, which would be a relatively minor maintenance task, the spillway capacity would be increased to 2,740 cfs. This would permit the accommodation of a flood with a peak inflow of 3,330 cfs, or 66 percent of the Lake Susquehanna PMF peak flow. The spillway capacity of Lake Susquehanna Dam would still be rated as inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observation.

(1) General. The visual inspection of Lake Susquehanna Dam resulted in a number of observations relevant to structural stability. These observations are listed herein for the various features.

(2) Embankment. A swampy area was located along the toe of the embankment. The detailed description and evaluation of the condition are in Paragraphs 3.1b.(5) and 3.2a.(5), respectively.

(3) Spillway. The riprap in the spillway discharge channel does not appear to have been placed in accordance with the plans. The detailed description and evaluation of the condition are in Paragraphs 3.1c.(1) and 3.2b.(1), respectively.

b. Design and Construction Data. The stability computations for the embankment were not reviewed. However, the factors of safety for the embankment design are reported in the soils investigation report that was prepared by Northeastern Engineering Company and also in the permit application report prepared by PennDER. The factors of safety for the various design conditions are as follows:

Case	Computed Factor of Safety	Factor or Safety Required
Construction	1.9	1.5
Steady Seepage	1.5	1.3
Rapid Drawdown	1.5	1.0

In each case the computed factor of safety for the embankment is greater than the required factor of safety. However, the report by Northeastern Engineering Company advised that care should be exercised to cutoff as much seepage as possible in the area where the foundation contains the clayey gravel strata and that special treatment of the foundation should be undertaken if it were found that the bottom of the cutoff trench were on broken shale. The report indicated that lack of care could result in large amounts of seepage and a potential piping situation. The estimated outflow from the toe drain in this area during this inspection was 14,400 gallons per day, which is significantly less than the 75,000 gallons per day estimate by Northeastern Engineering Company for the condition of having an ineffective seepage control system. Therefore, it appears that the measures that were used did reduced the potential seepage by an appreciable amount.

c. Operating Records. Other than some minor sloughing on the downstream slope of the embankment, which apparently occurred prior to the establishment of good vegetal cover, there is no evidence that any stability problems have occurred for the dam or the spillway since the dam was completed in 1973. The excellent condition of the spillway structures indicates that they have performed as intended.

d. Post-Construction Changes. There have been no known modifications to the dam or the appurtenant structures.

e. Seismic Stability. This dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on the visual inspection, available records, calculations and past operational performance, Lake Susquehanna Dam is judged to be in good condition. However, deficiencies of varying degree of importance were noted. A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiencies
Embankment:	
Top of embankment	Low area near spillway; lack of vegetation.
Upstream slope	Light brush.
Downstream toe	Swampy area 400 feet from right abutment.
Toe drain outlet	Accumulation of sandy clay in outlet; piles of sand and fine gravel near outlet.
Spillway:	
Discharge channel	Riprap placement not uniform and not constructed in accordance with design.
Outlet Works:	
Outlet structure	Accumulation of mud, sand, and fine gravel.

(2) The overtopping potential analysis shows that Lake Susquehanna Dam will be overtopped by the PMF. If Lake Susquehanna Dam should be overtopped, it would probably fail by embankment

erosion. Based on OCE criteria, as outlined in Paragraph 5.1a.(2), the spillway capacity is rated as inadequate. Hydrologic and hydraulic analyses show that the spillway capacity is sufficient to pass one-half the PMF; therefore, based on the criteria (OCE guidelines), the spillway capacity is not rated as seriously inadequate. The existing spillway can accommodate a flood with a peak inflow of 56 percent of the PMF peak inflow. The spillway capacity is controlled by the elevation of a low area on the embankment adjacent to the spillway. If the low area were brought up to design elevation, the existing spillway would accommodate a flood with a peak inflow of 66 percent of the PMF peak inflow. The spillway would still be rated as inadequate.

(3) Review of available data concerning stability of the embankment and the visual inspection of the dam and the appurtenant structures indicate that they are adequate for the maximum design conditions.

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented immediately or in a timely manner, as noted.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations will be required.

7.2 Recommendations and Remedial Measures.

a. In view of the concern for safety of Lake Susquehanna Dam, the following measures are recommended to be undertaken by the Owner immediately:

(1) Perform surveys to establish the extent of the low area on the embankment and fill in the area to design grade.

(2) Fill gaps in riprap in spillway discharge channel with derrick stone. Perform additional study to determine the adequacy of the gradation and extent of riprap in the spillway discharge channel and outlet channel, and make any improvements that are found to be necessary.

(3) Develop a detailed emergency operation and warning system for Lake Susquehanna Dam.

b. In order to correct operational, maintenance and repair deficiencies, and to more accurately determine the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Remove brush growing on upstream slope of embankment.

(2) Either limit the travel of vehicles on the top of the embankment to amounts that vegetation can bear or make proper provisions for vehicular traffic.

(3) Make such modifications as necessary to ensure positive drainage of surface runoff in the swampy area.

(4) Measure and record outflow from the toe drain outlets on a frequent basis so that any change in quantity can be detected.

(5) Install two or more observation wells or other instrumentation in the embankment in the vicinity of the swampy area. The wells should be placed downstream from the cutoff and should extend into the clayey gravel strata in the foundation. One or more additional wells or other instrumentation should be located in the remainder of the embankment. Monitor and keep records of water levels so any change in conditions is apparent.

(6) Remove the accumulation of mud, sand, and fine gravel from the outlet works outlet structure and make operating tests to determine whether the materials have come from the reservoir or from the toe drain outlets.

c. In addition, the following operational measures are recommended to be undertaken by the Owner:

(1) Provide round-the-clock surveillance of Lake Susquehanna Dam during periods of unusually heavy rains.

(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

(3) Implement an annual inspection program of all project features and maintain inspection records.

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL AND LUZERNE COUNTIES

PENNSYLVANIA

LAKE SUSQUEHANNA DAM

NDS ID No. PA-00818
DER ID No. 54-177

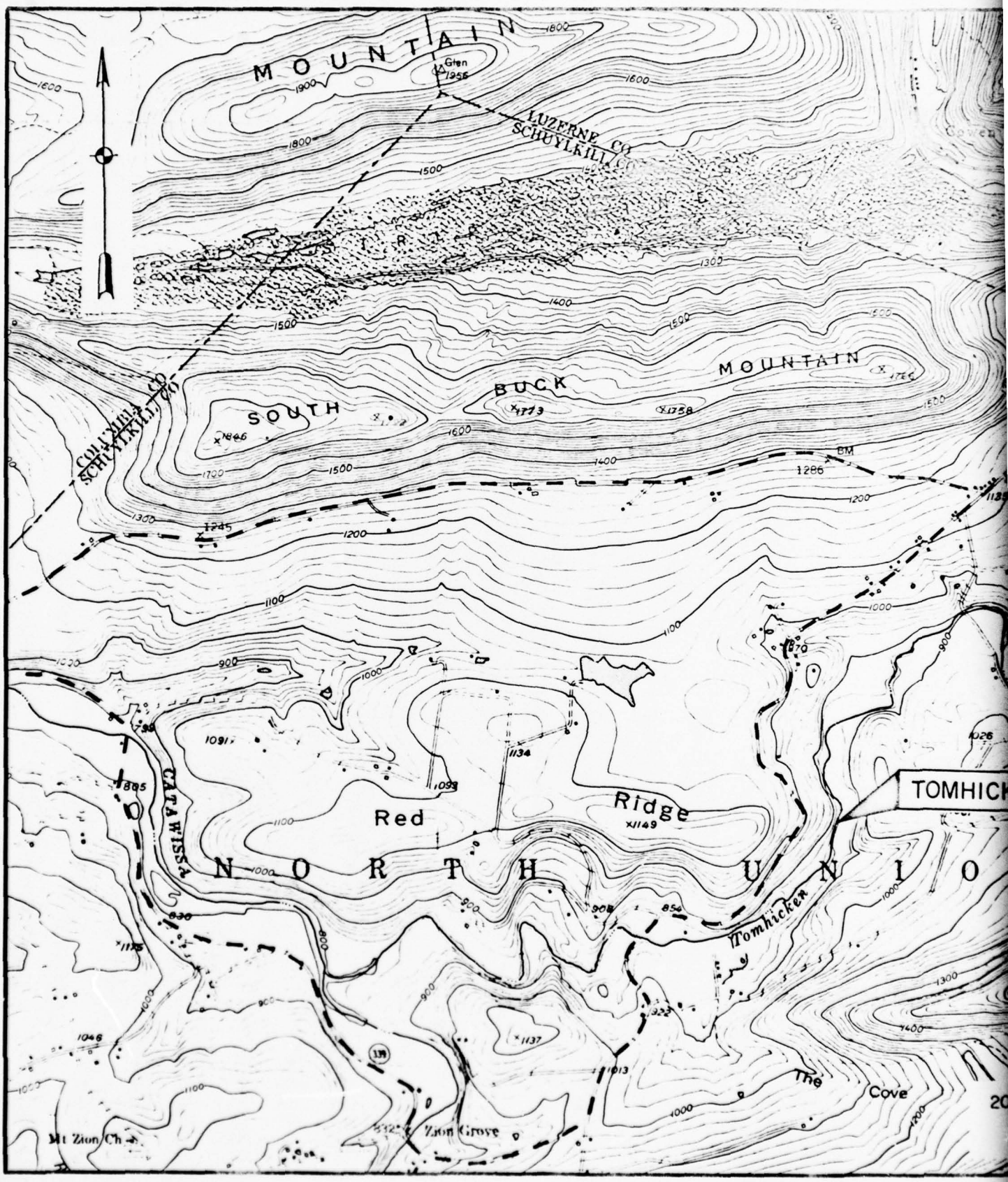
HIGH VISTA, INC.

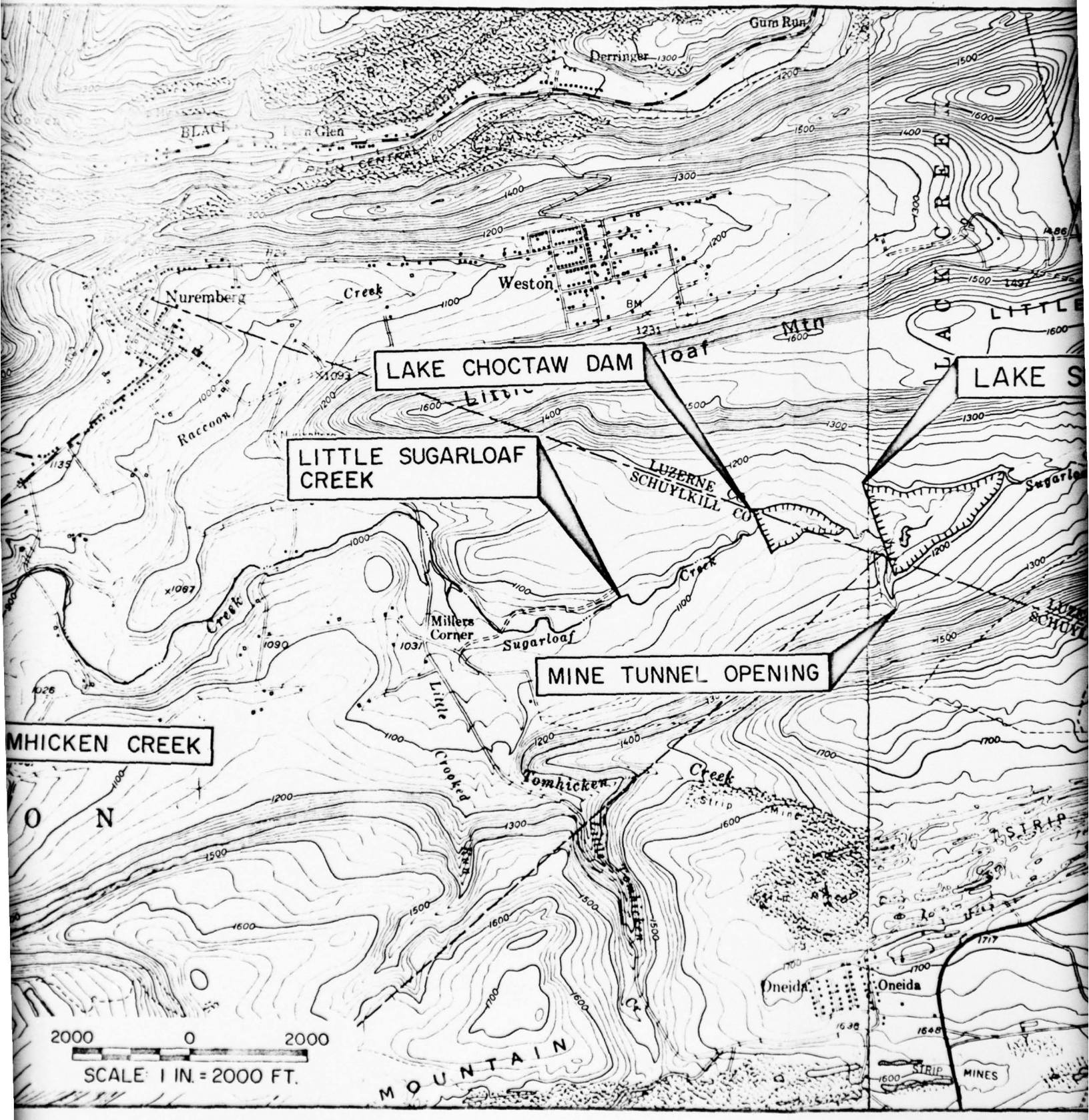
PHASE I INSPECTION REPORT

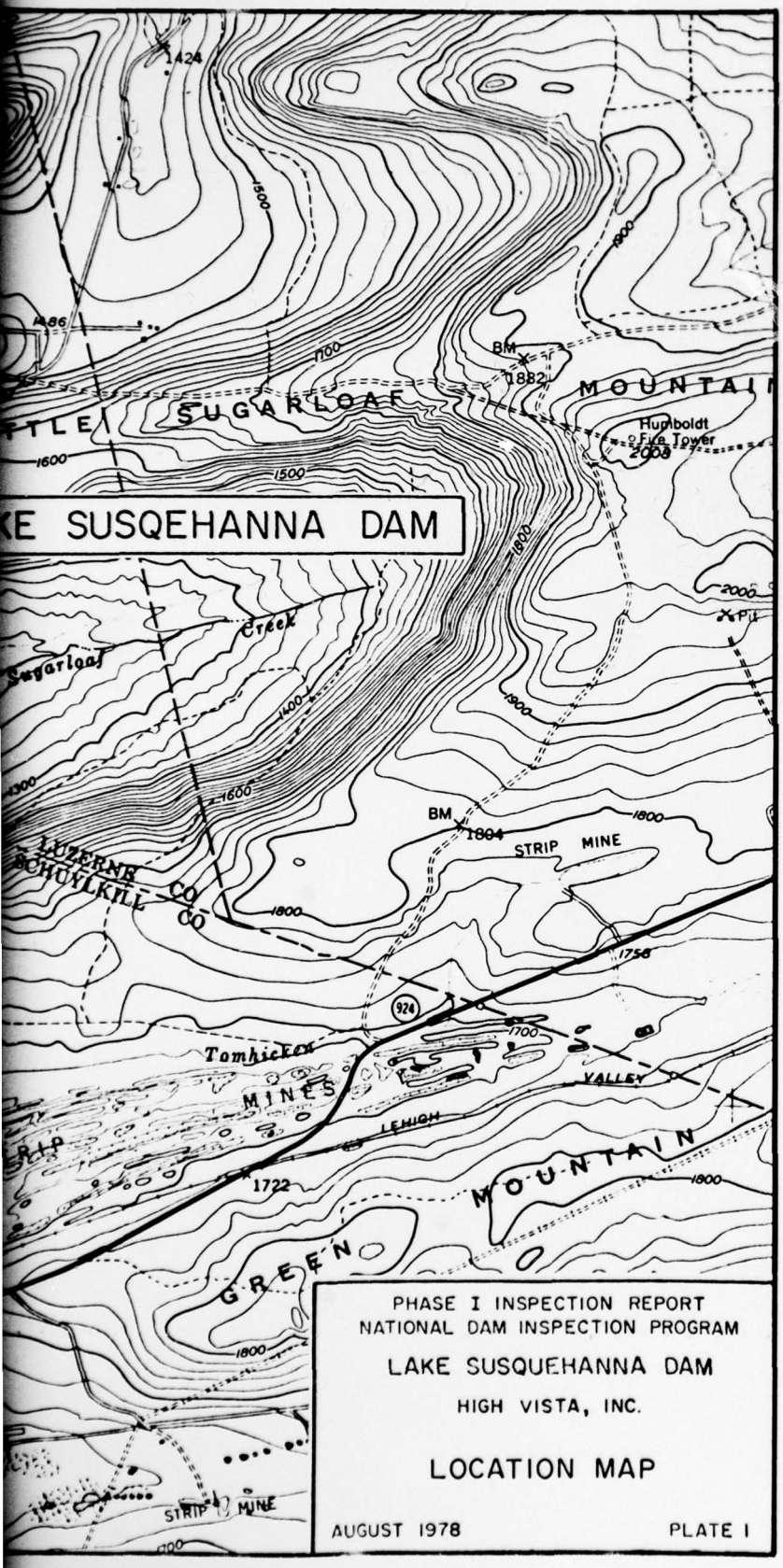
NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

PLATES


MOUNTAIN
Glen
1955
LUZERNE CO
SCHUYLKILL CO
SOUTH
BUCK
MOUNTAIN
1773
1758
1846
1745
BM
1286
Red
Ridge
1149
NORTH
MOUNTAIN
CATAWISSA
Tomhicken
TOMHICK
Mt Zion Ch
Zion Grove
The
Cove


LAKE CHOCTAW DAM
LITTLE SUGARLOAF CREEK
MINE TUNNEL OPENING
Gum Run
Derringer
Weston
Nuremberg
Creek
Raccoon
Millers Corner
Sugarloaf
Little
Crooked
Tomhicken
Creek
Oneida
Oneida
STRIP MINES
MOUNTAIN
2000 0 2000
SCALE 1 IN. = 2000 FT.



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE SUSQUEHANNA DAM

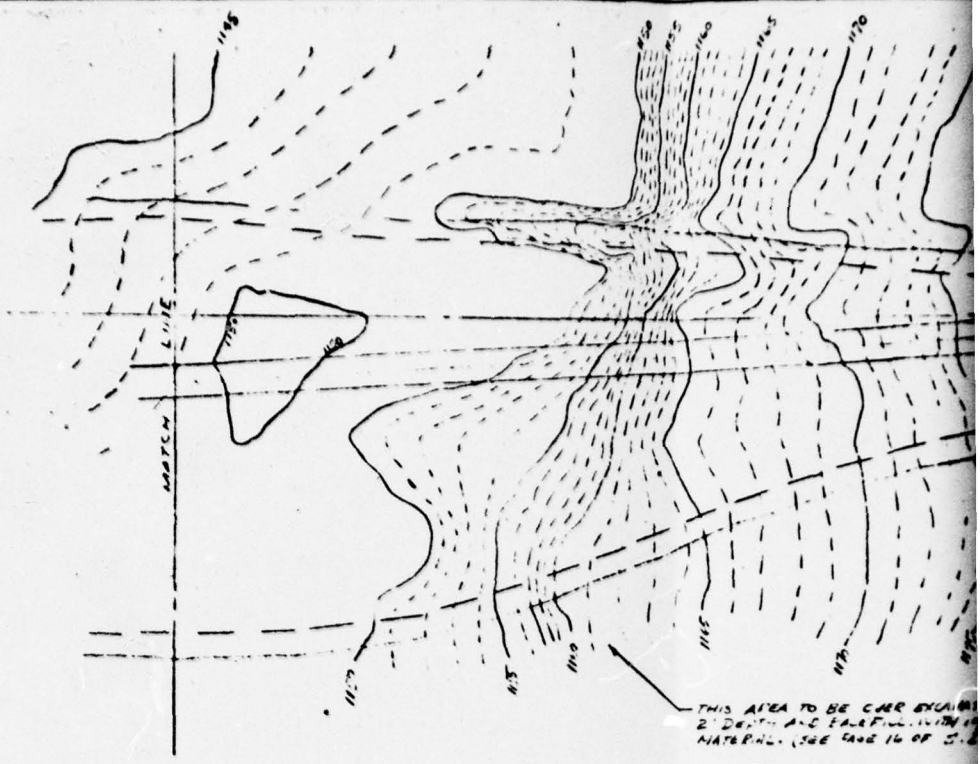
HIGH VISTA, INC.

LOCATION MAP

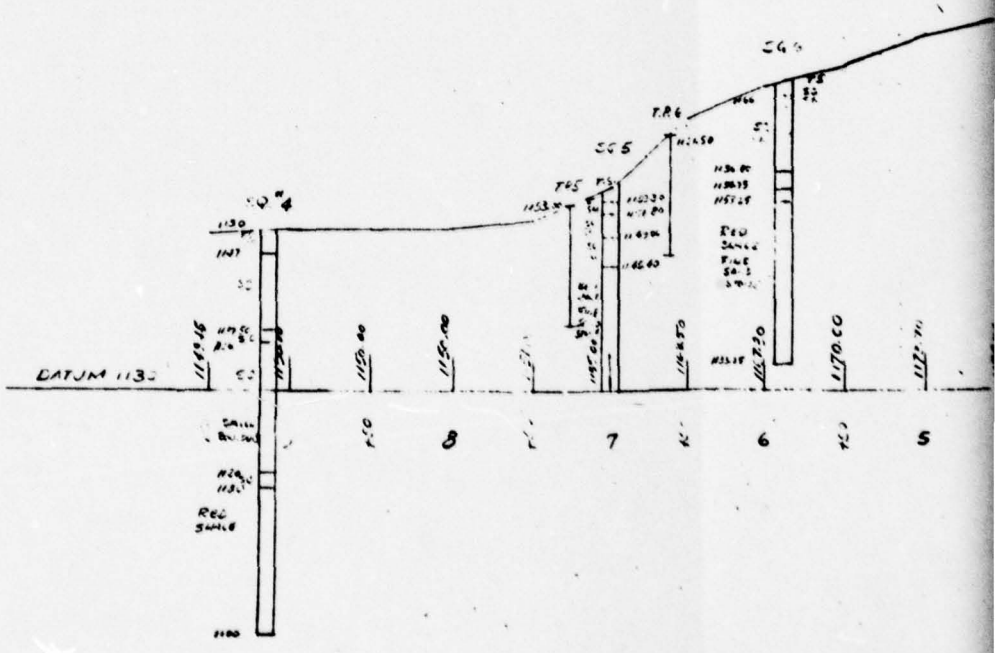
AUGUST 1978 PLATE 1

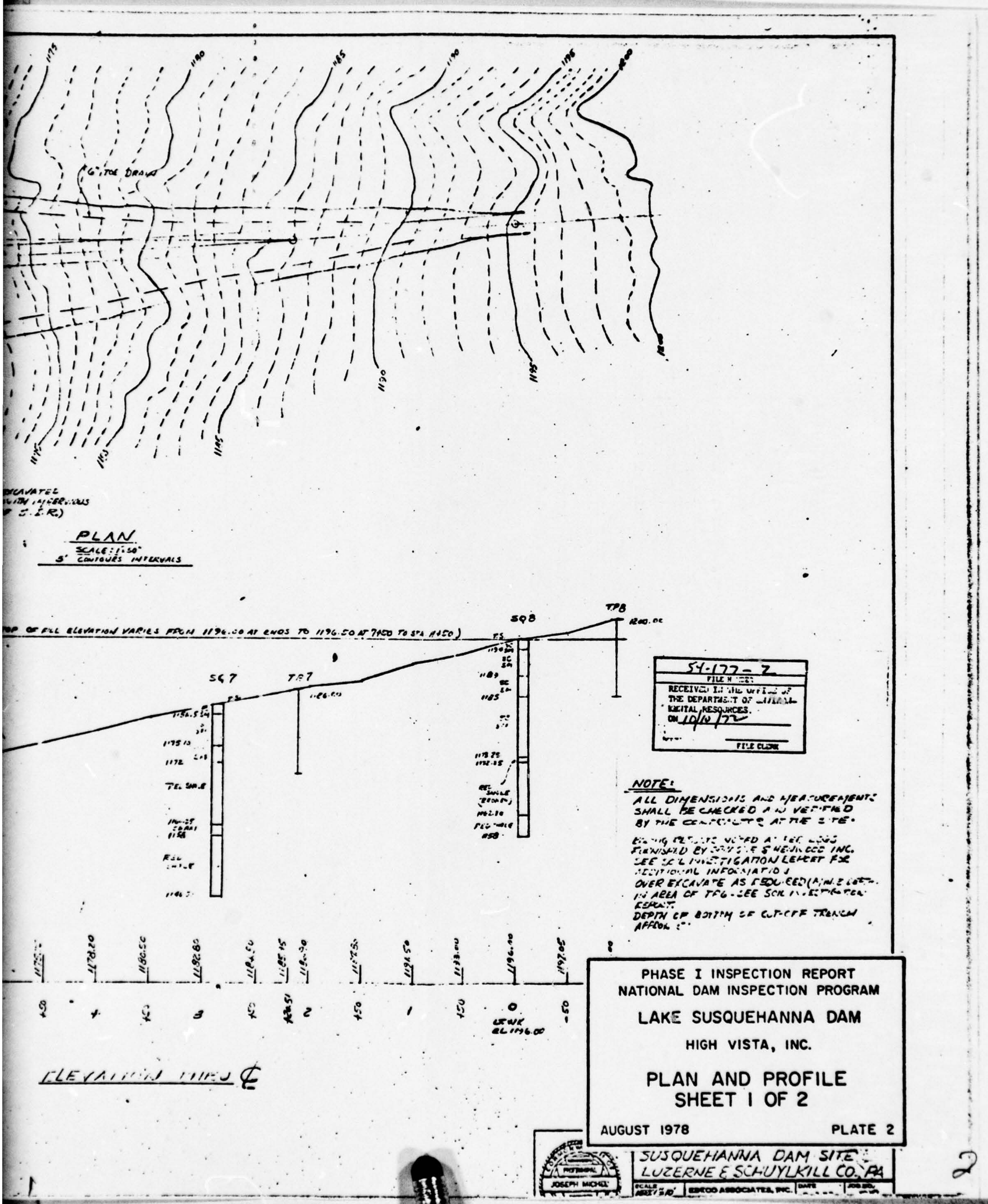
2 1

3



EL. 1136.00 FOR ... (NOTE: TOP ...





PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

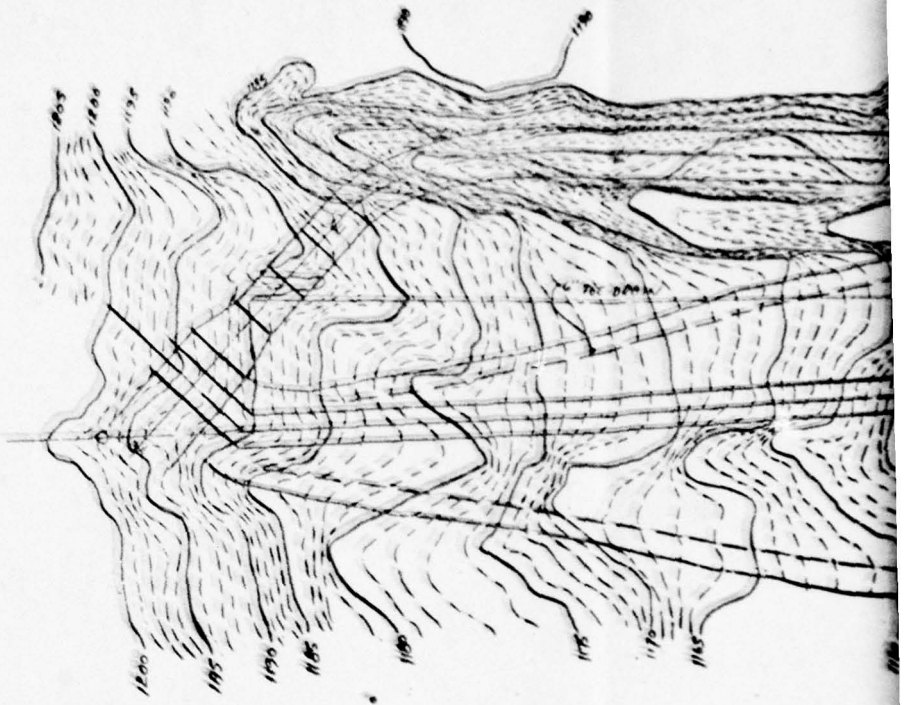
LAKE SUSQUEHANNA DAM

HIGH VISTA, INC.

PLAN AND PROFILE
SHEET 1 OF 2

AUGUST 1978 PLATE 2

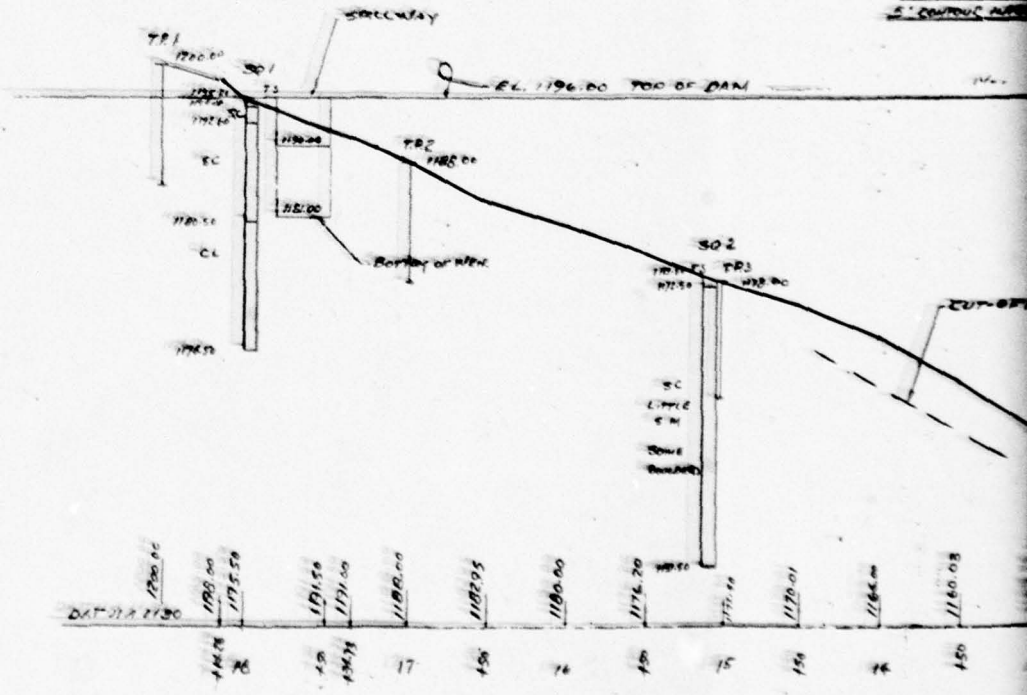
2



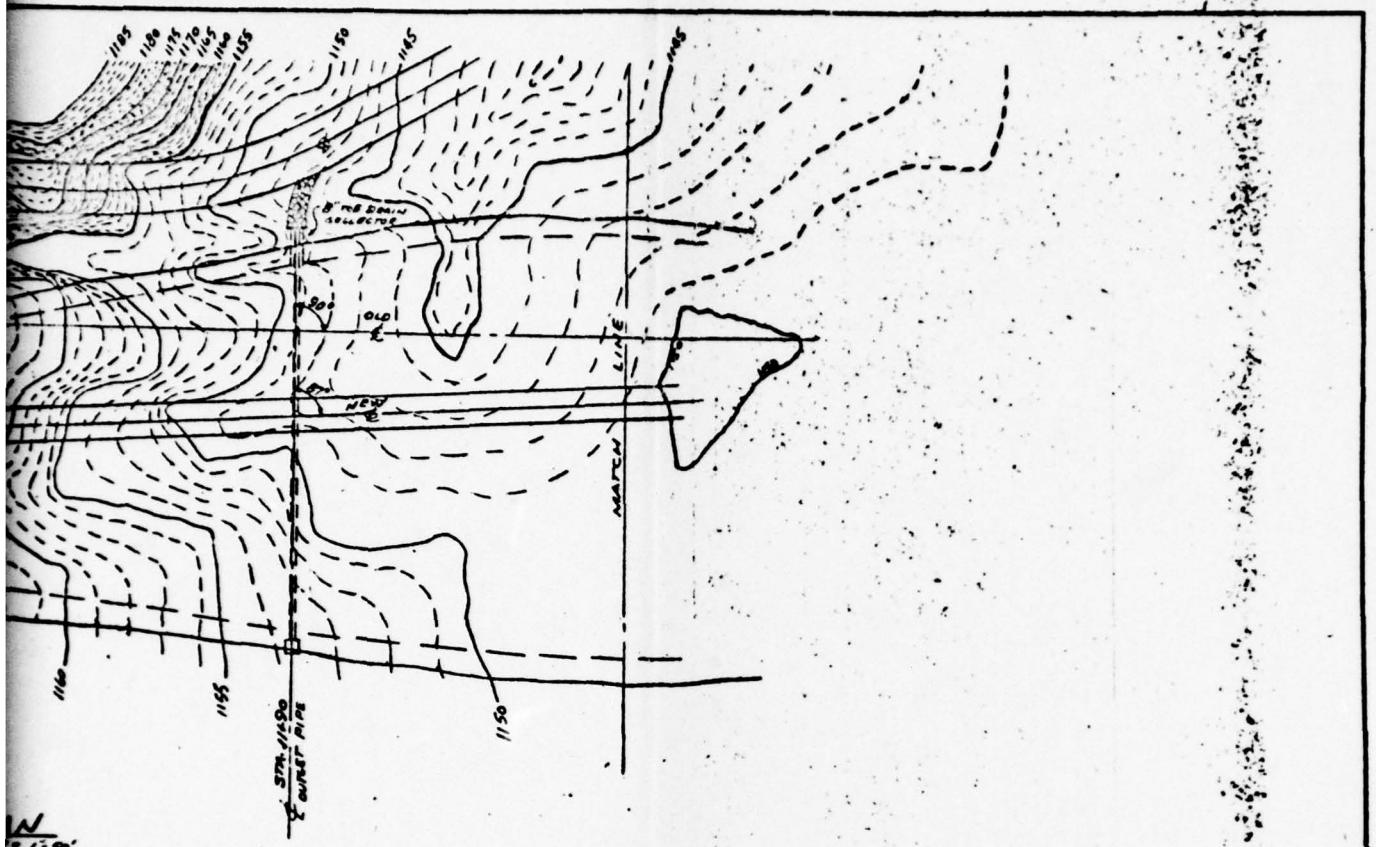
PLAN

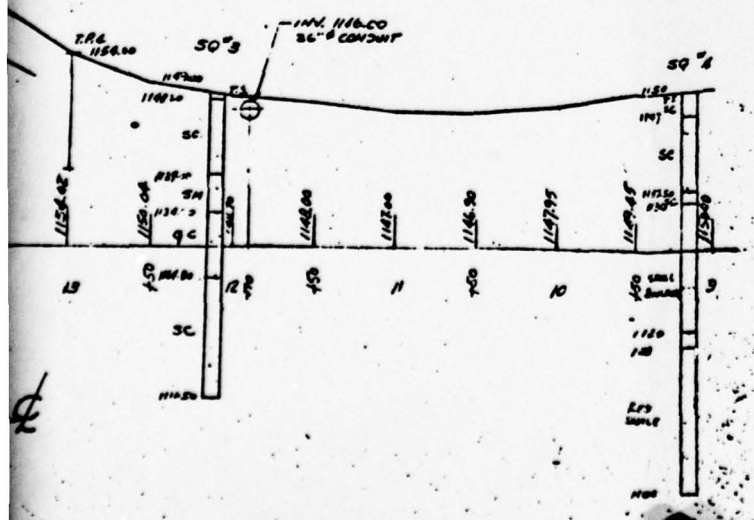
SCALE: 1"

5' CONTOUR INT.



ELEVATION THRU ℄





54-177-3
FILE NUMBER
RECEIVED IN THE OFFICE OF
THE DEPARTMENT OF ENVIRONMENTAL RESOURCES
ON 10/18/78

NOTES:
BORING RESULTS NOTED AS PER LOGS FURNISHED BY SPRAGUE & HENWOOD INC.
SEE SOIL INVESTIGATION REPORT FOR ADDITIONAL INFORMATION
OVER EXCAVATE AS REQUIRED (MIN. 2' DEPTH) IN AREA OF TP 6 - SEE SOIL INVESTIGATION REPORT.
DEPTH OF BOTTOM OF CUT-OFF TRENCH - APPROX. 8'

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE SUSQUEHANNA DAM

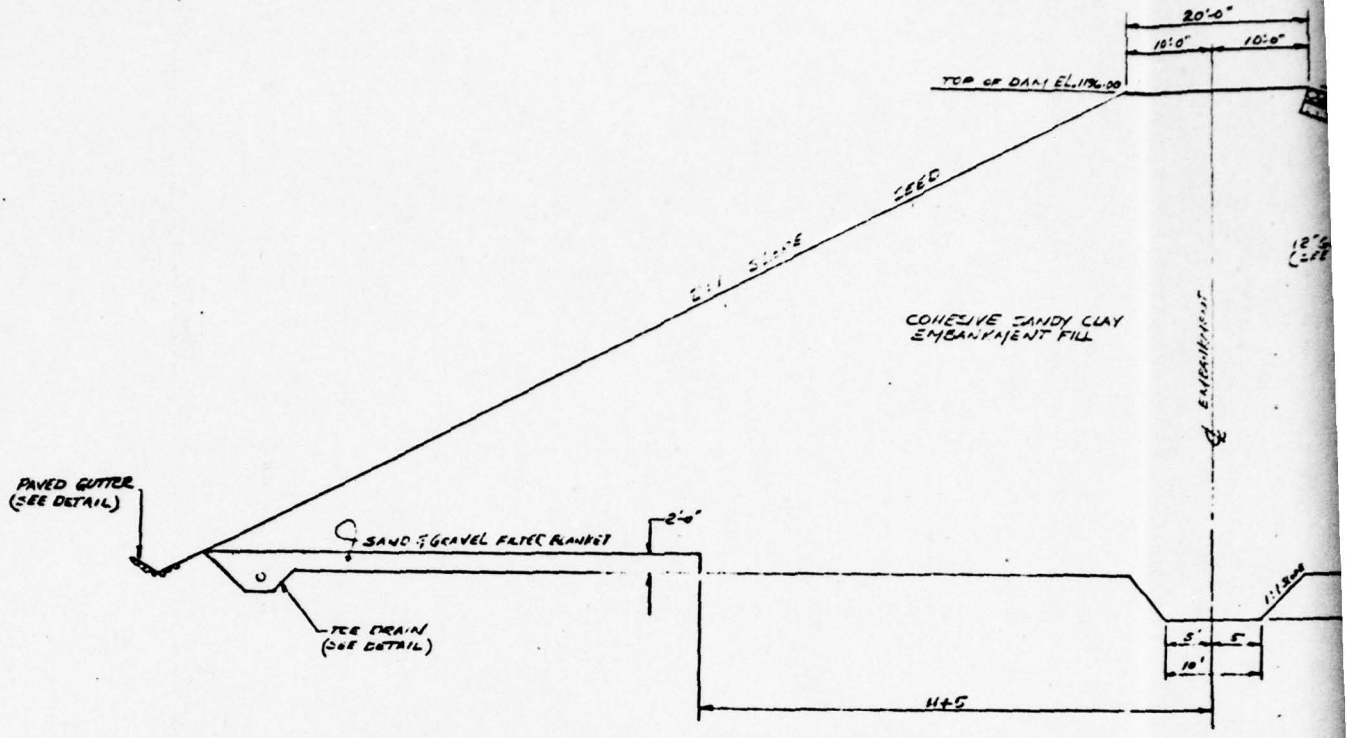
HIGH VISTA, INC.

PLAN AND PROFILE
SHEET 2 OF 2

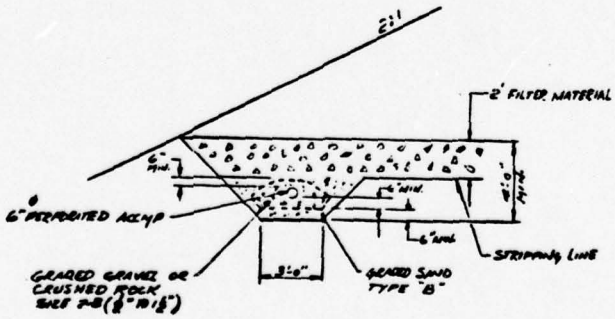
AUGUST 1978 PLATE 3

SUSQUEHANNA DAM SITE
LUZERNE & SCHUYLKILL CO., PA.

2



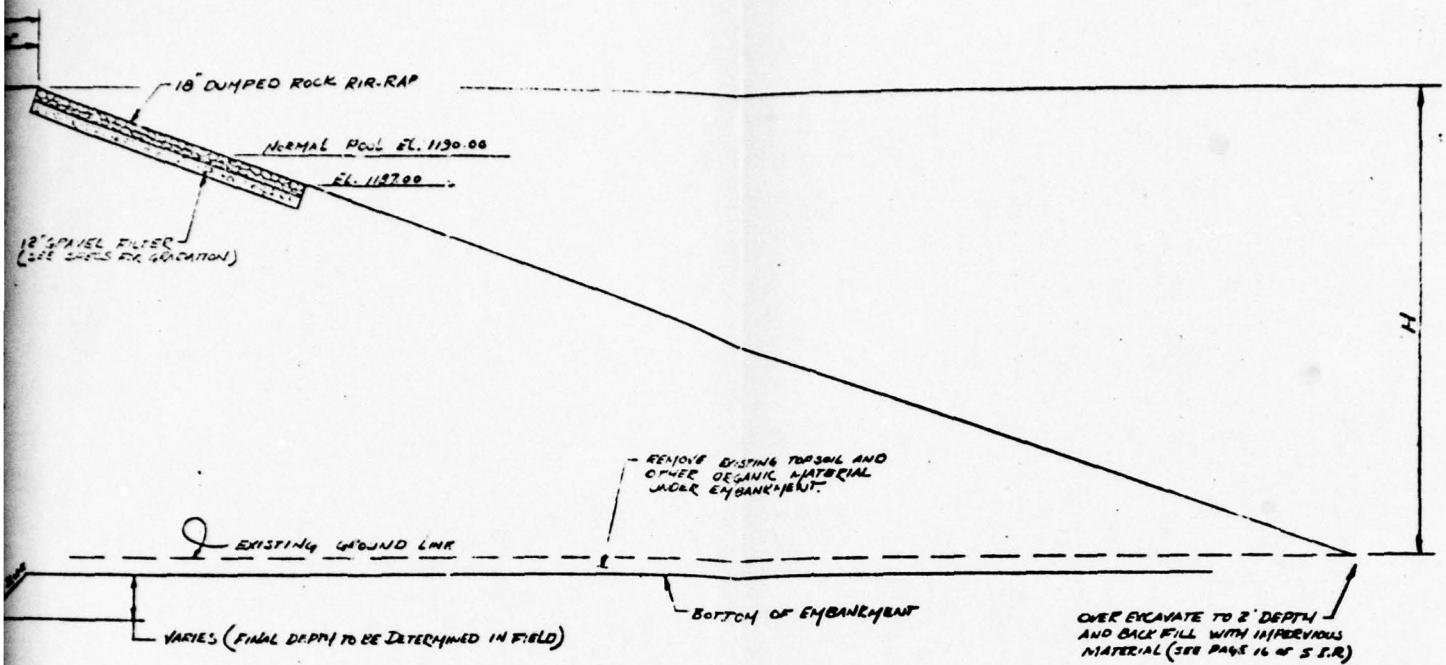
EMBANKMENT - TYPI
SCALE: 1" =



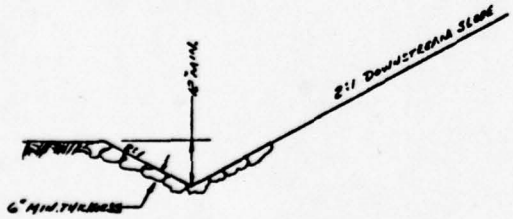
DETAIL - TOE DRAIN INSTALLATION
SCALE 1" = 2'-0"

FILTER GRADATION (TO BE APPROVED BY ENG. IN THE FIELD)

SIEVE SIZE	% BY WEIGHT PASSING
1½"	100 %
#4	60 - 70 %
#20	20 - 45 %
#40	10 - 40 %
#60	5 - 25 %
#200	3 %



TYPICAL SECTION
1" = 10'



DETAIL - PAVED GUTTER
SCALE: 1" = 10'

54-177-4
FILE NUMBER

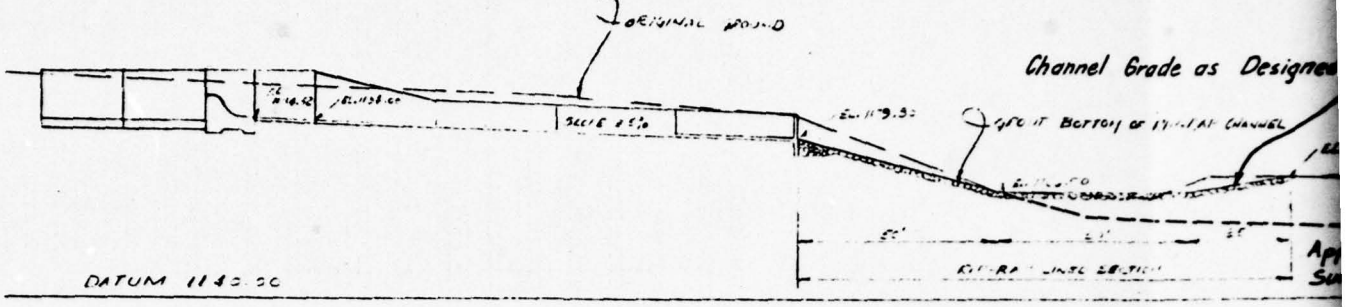
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE SUSQUEHANNA DAM

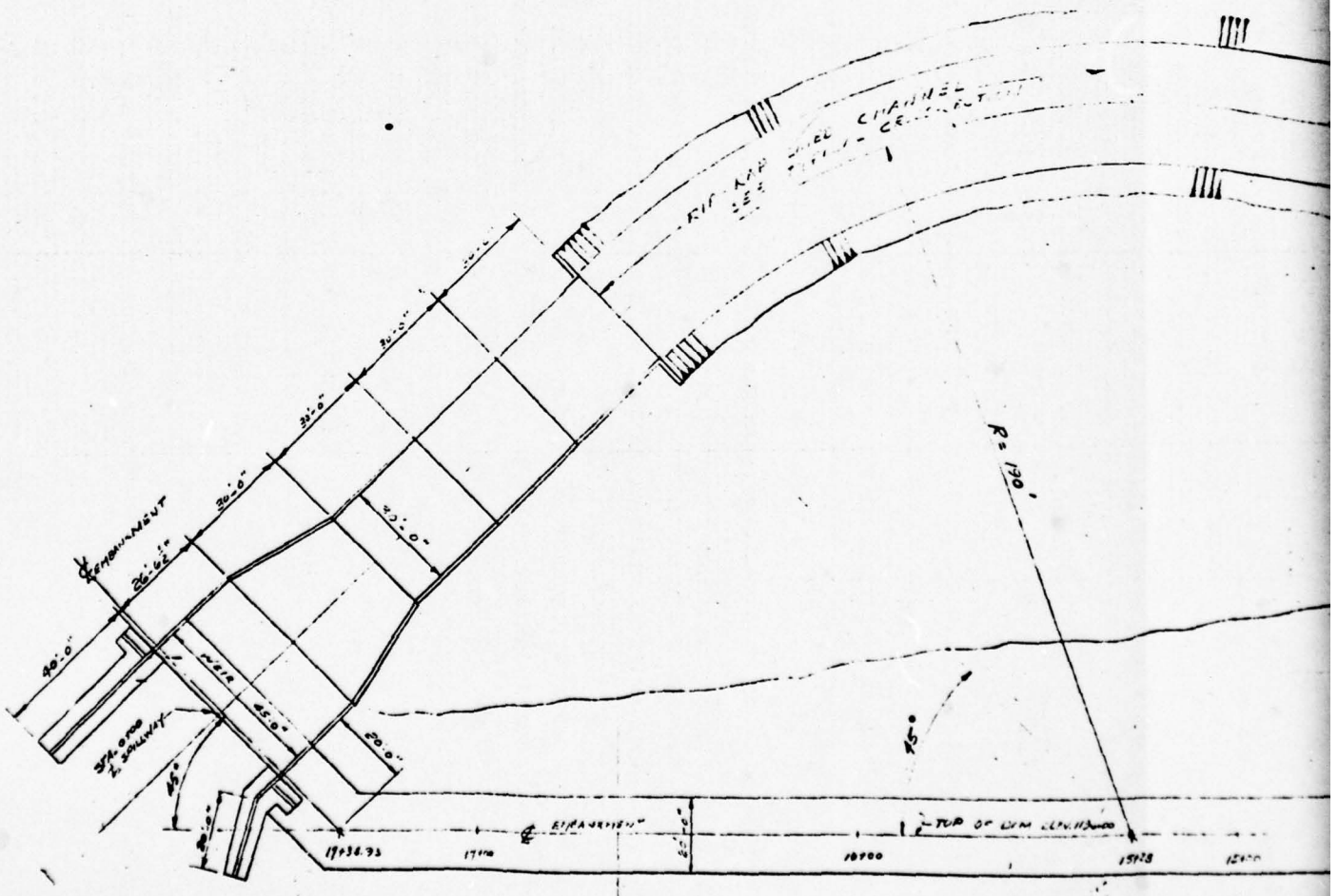
HIGH VISTA, INC.

TYPICAL EMBANKMENT SECTION

AUGUST 1978 PLATE 4



PROFILE ALONG ℄ SPILLWAY CHANNEL
SCALE: 1" = 5'



PLAN
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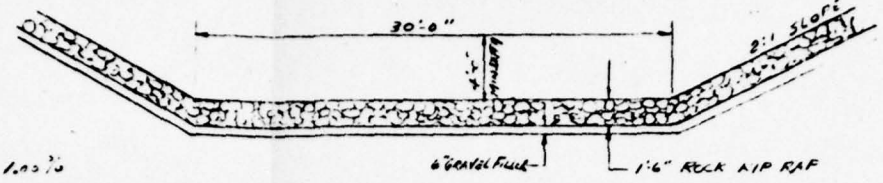


WASTEWAY CHANNEL SECTION
SCALE 1" = 5'-0"

signed

ORIGINAL GROUND

EL. 1170.00

SLOPE OF CHANNEL = 1.00%

Approx. Channel Grade as Surveyed by G.F.C.I.C, June 1978

LOCATION SOUTH

155'-0"

N20°48'30"W

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE SUSQUEHANNA DAM

HIGH VISTA, INC.

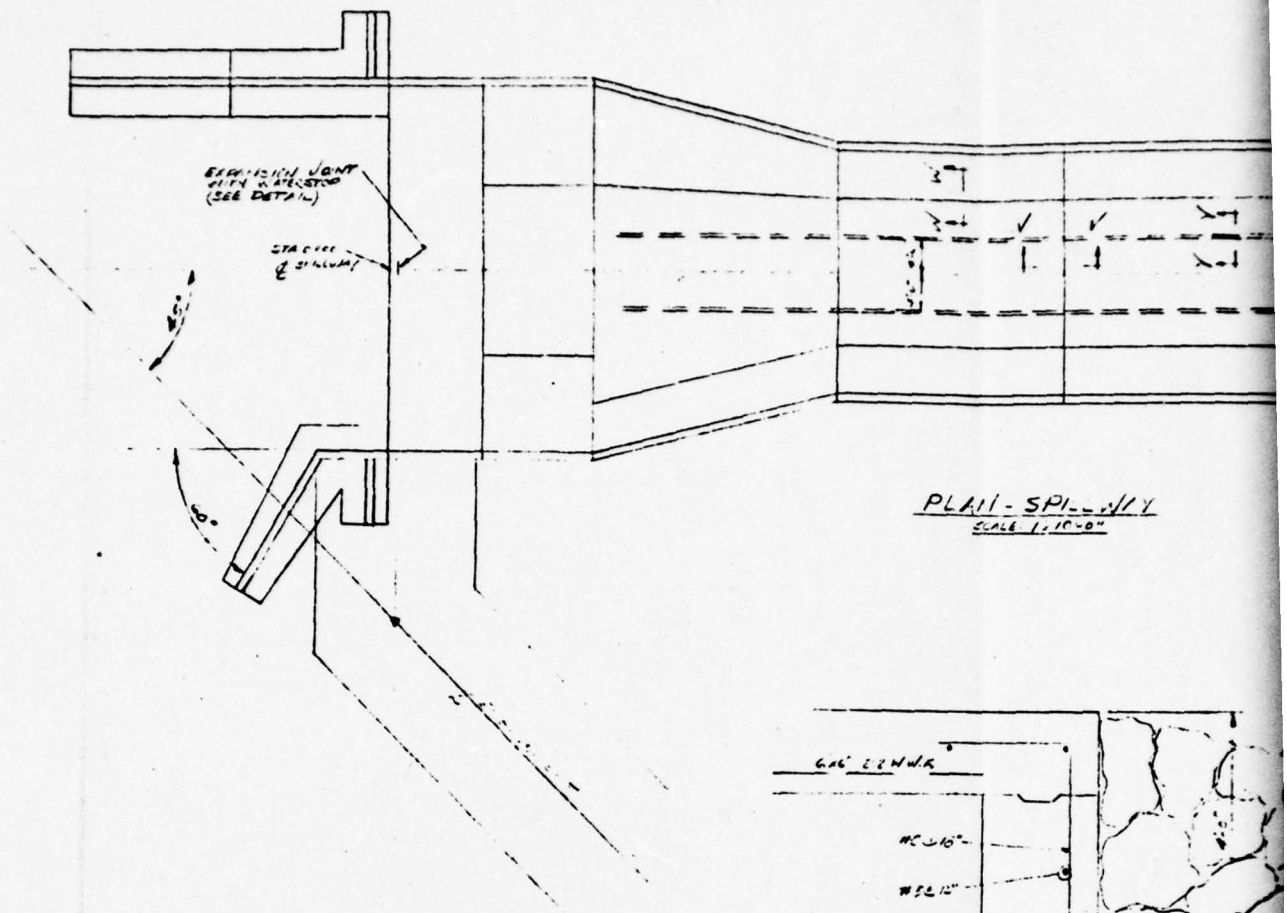
SPILLWAY PLAN AND PROFILE

AUGUST 1978 PLATE 5

SCALE NOTED	EBECO ASSOCIATES, INC CONSULTING ENGINEERS SURVEYORS · OCEANOGRAPHERS · PLANNERS 110 W. CARLETON AVENUE CHARLESTON, S.C. 29401	DATE 9-15-78	JOB NO. 61-3
DRAWN BY M. SMAR		DRAWING NUMBER 1701	

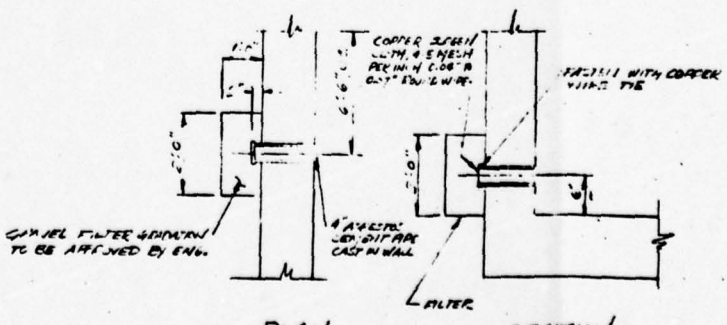
Rev 1 | 10-1-78 | M.C.

2



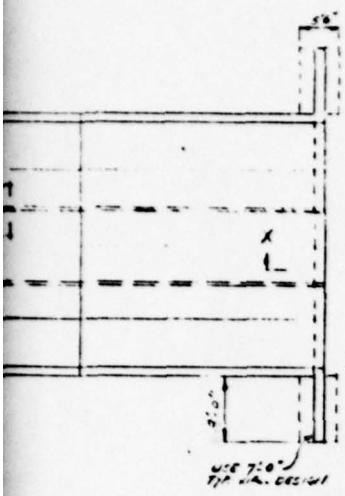
PLAN - SPILLWAY
SCALE 1:10-0"

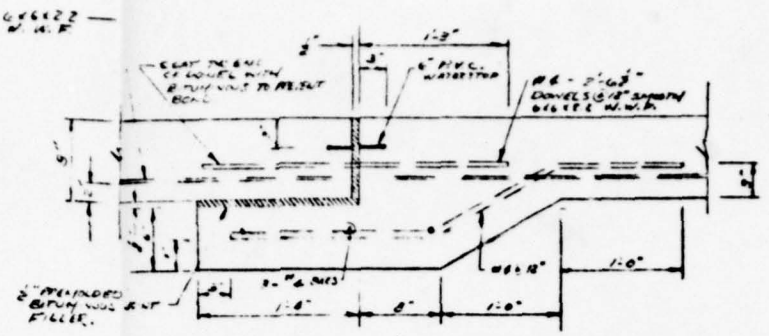
SECTION X-X
SCALE 1/2"=1'-0"



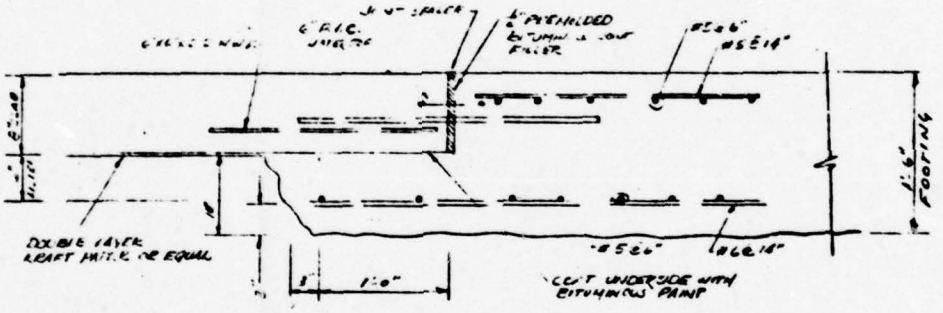
PLAN SECTION

DETAIL - WEEP HOLES
SCALE: 1"=1'-0"

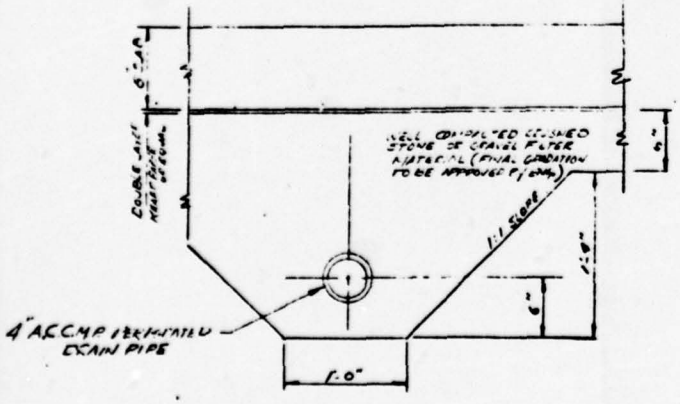




SECTION V-V
SCALE: 1/2" = 1'-0"



SECTION W-W
SCALE: 1/2" = 1'-0"



SECTION Y-Y
DETAIL - SLAB UNDERDRAIN
SCALE: 1/2" = 1'-0"

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

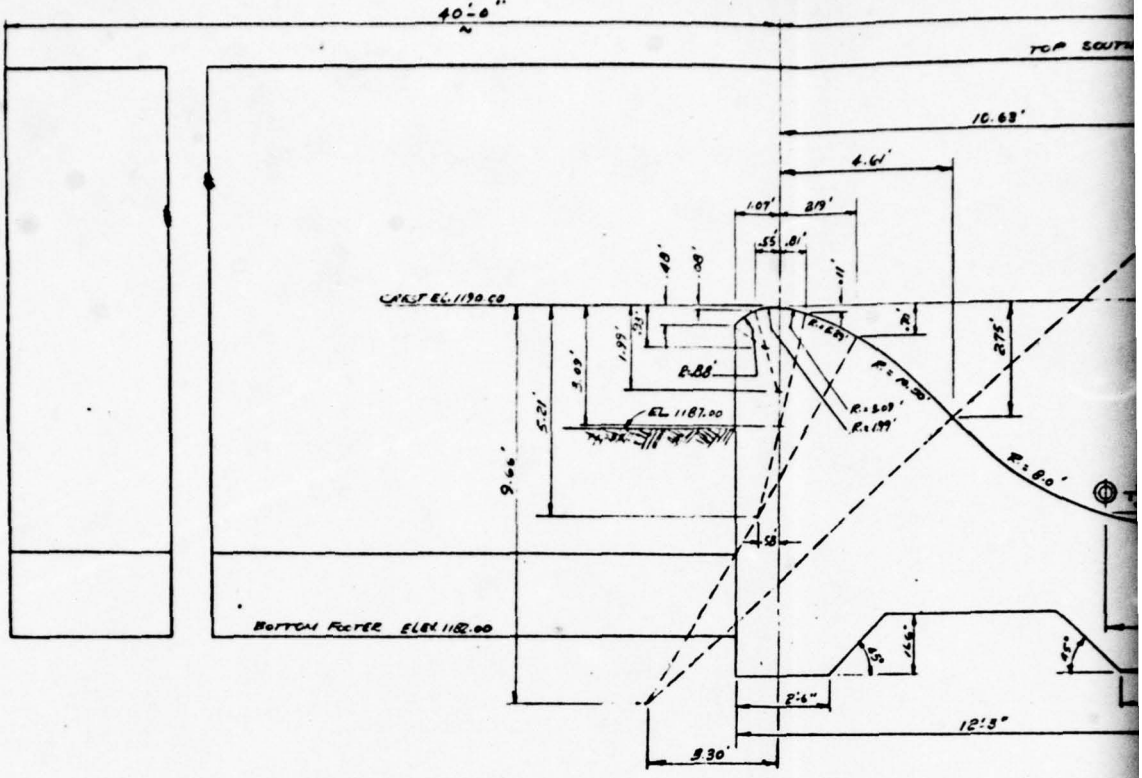
LAKE SUSQUEHANNA DAM

HIGH VISTA, INC.

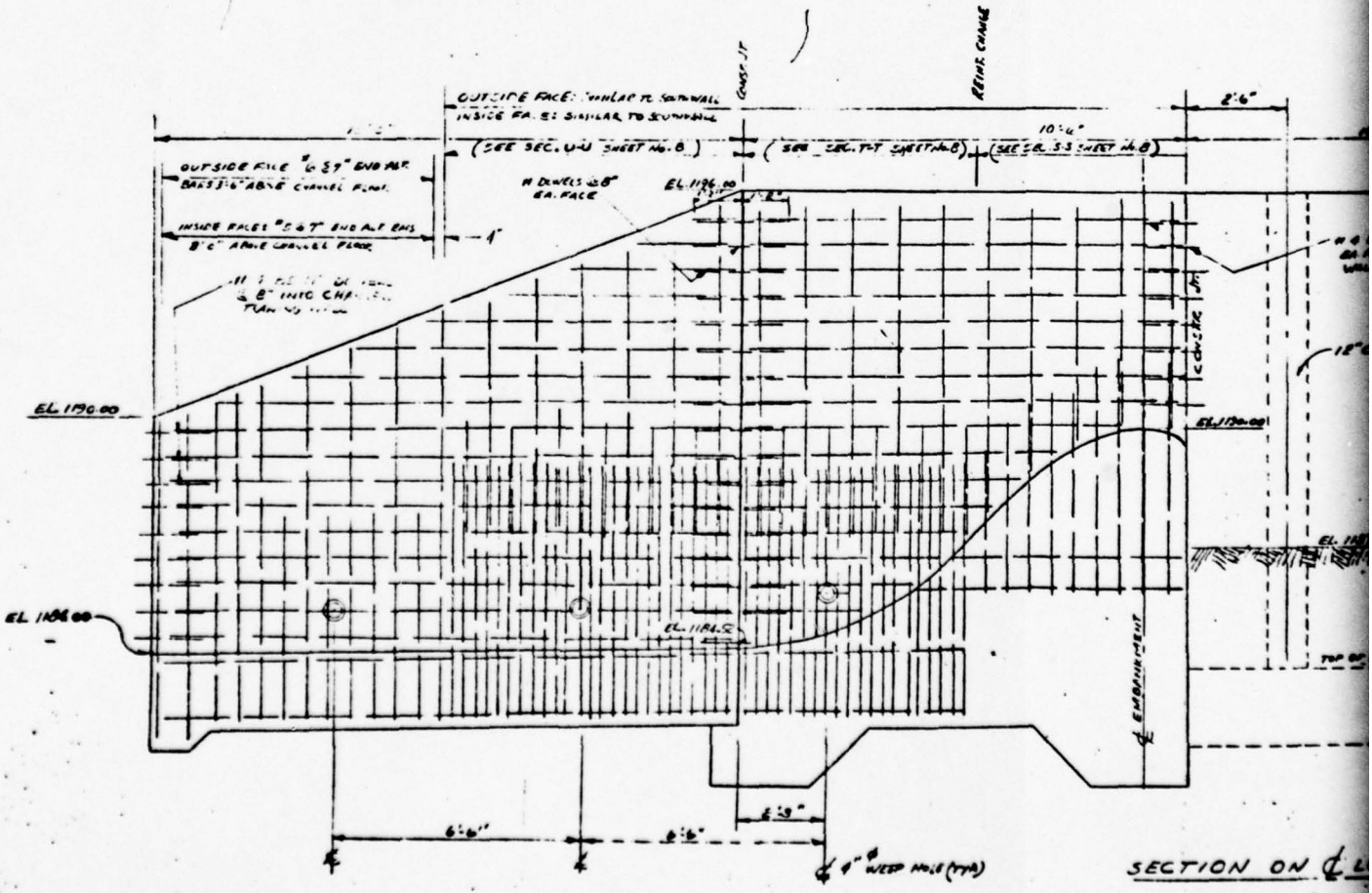
SPILLWAY DETAILS
SHEET 1 OF 2

AUGUST 1978 PLATE 6

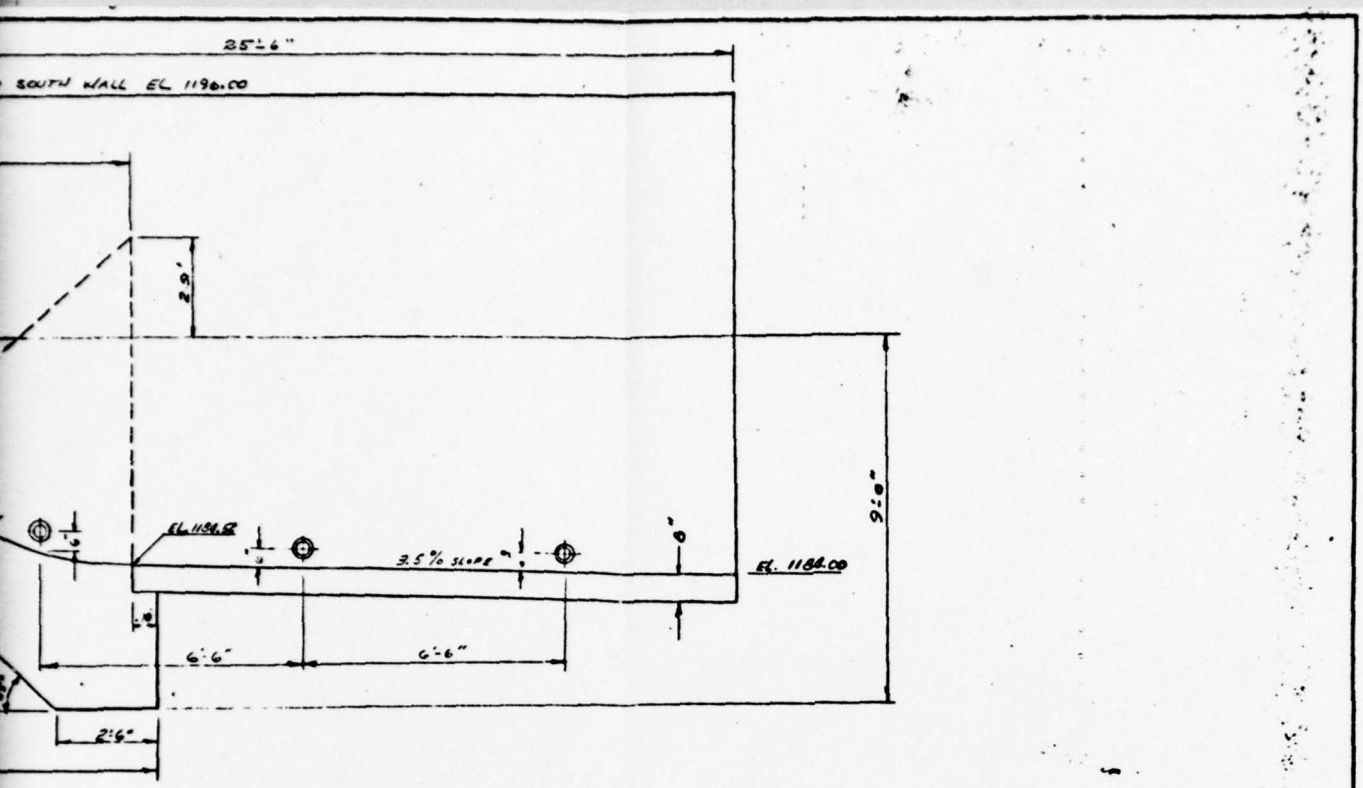
REVISIONS			DESIGN BY		DRAWING NUMBER
A	10-9-72	N.L.	M.SHAR		1701



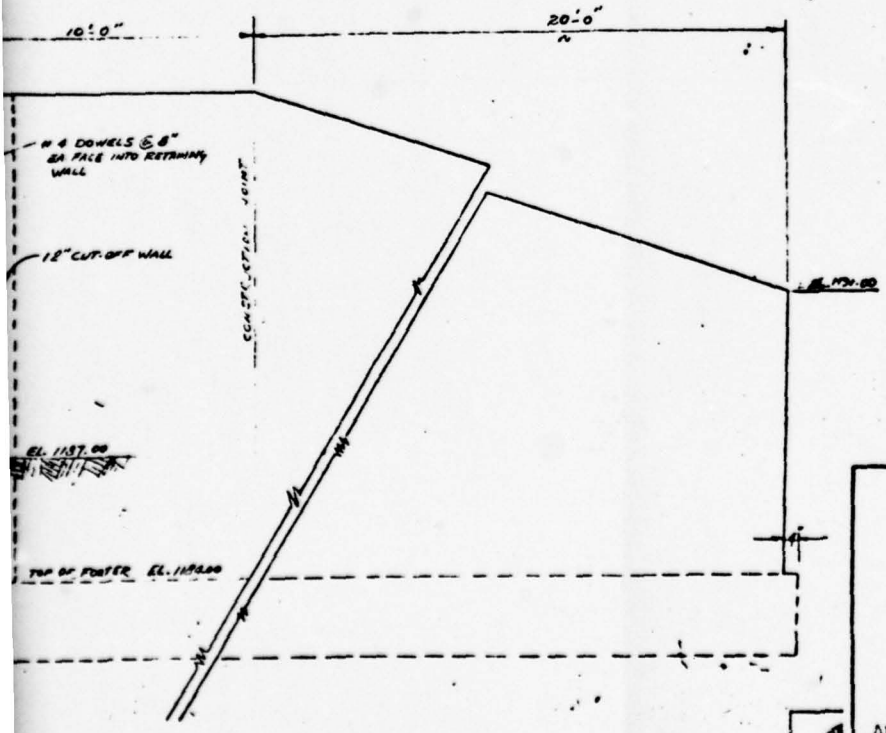
SECTION ON ℄ SPILLWAY



SECTION ON ℄ L



LWAY LOOKING SOUTH



℄ LOOKING NORTH

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE SUSQUEHANNA DAM

HIGH VISTA, INC.

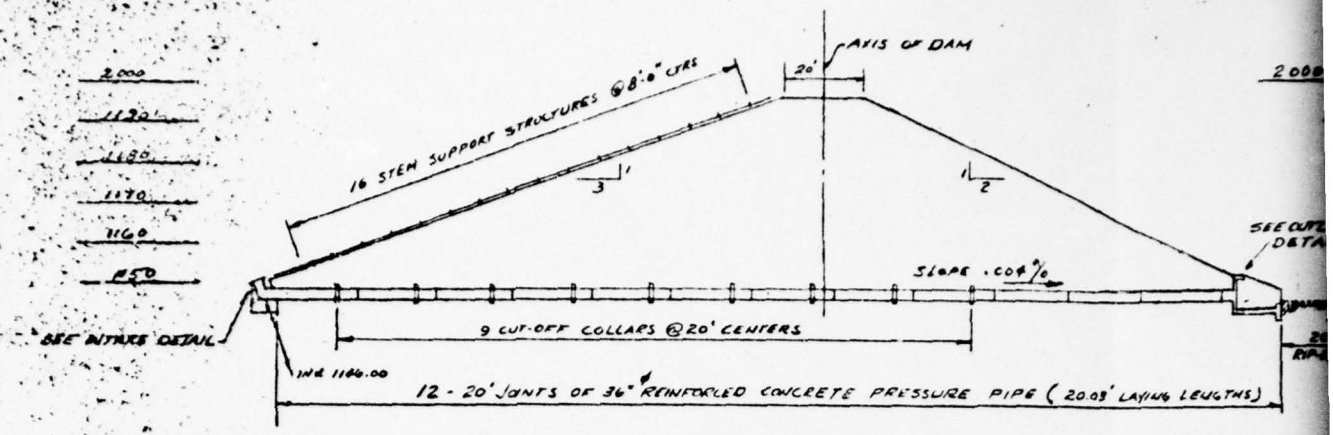
SPILLWAY DETAILS
SHEET 2 OF 2

AUGUST 1978 PLATE 7

LUZERNE & SCHUYLKILL CO., PA.

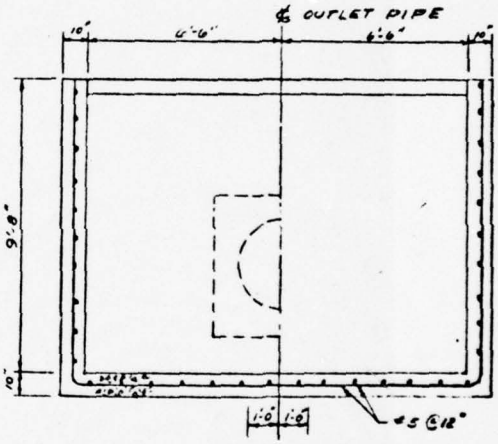
SCALE 1/4"=1'-0"	GANNETT FLEMING CORDDRY & CARPENTER, INC.	DATE 9-5-78	JOB NO. 613
DESIGN BY	DRAWN BY	CHECKED BY	APPROVED BY

2



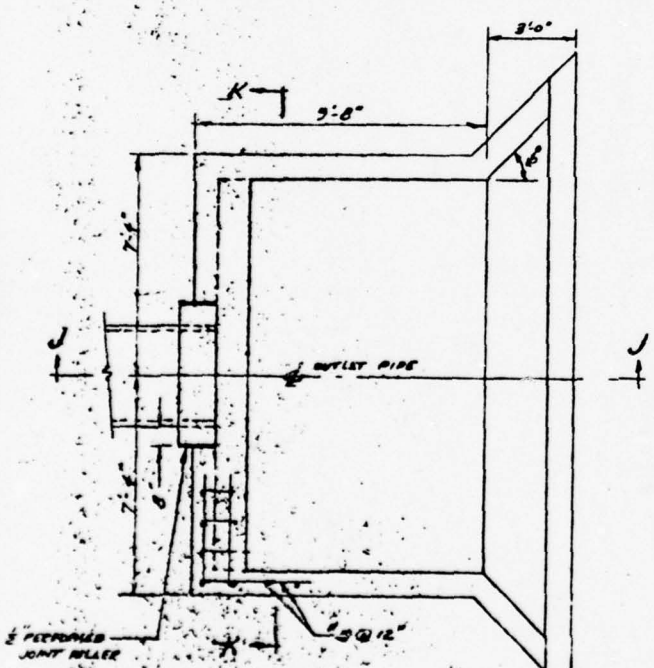
SECTION ON ℄ OF OUTLET PIPE

SCALE 1" = 20'



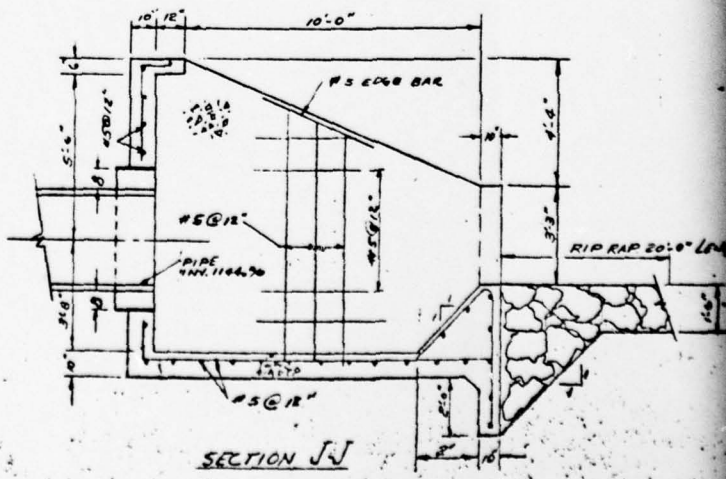
SECTION K-K

SCALE 3/8" = 1'-0"



PLAN

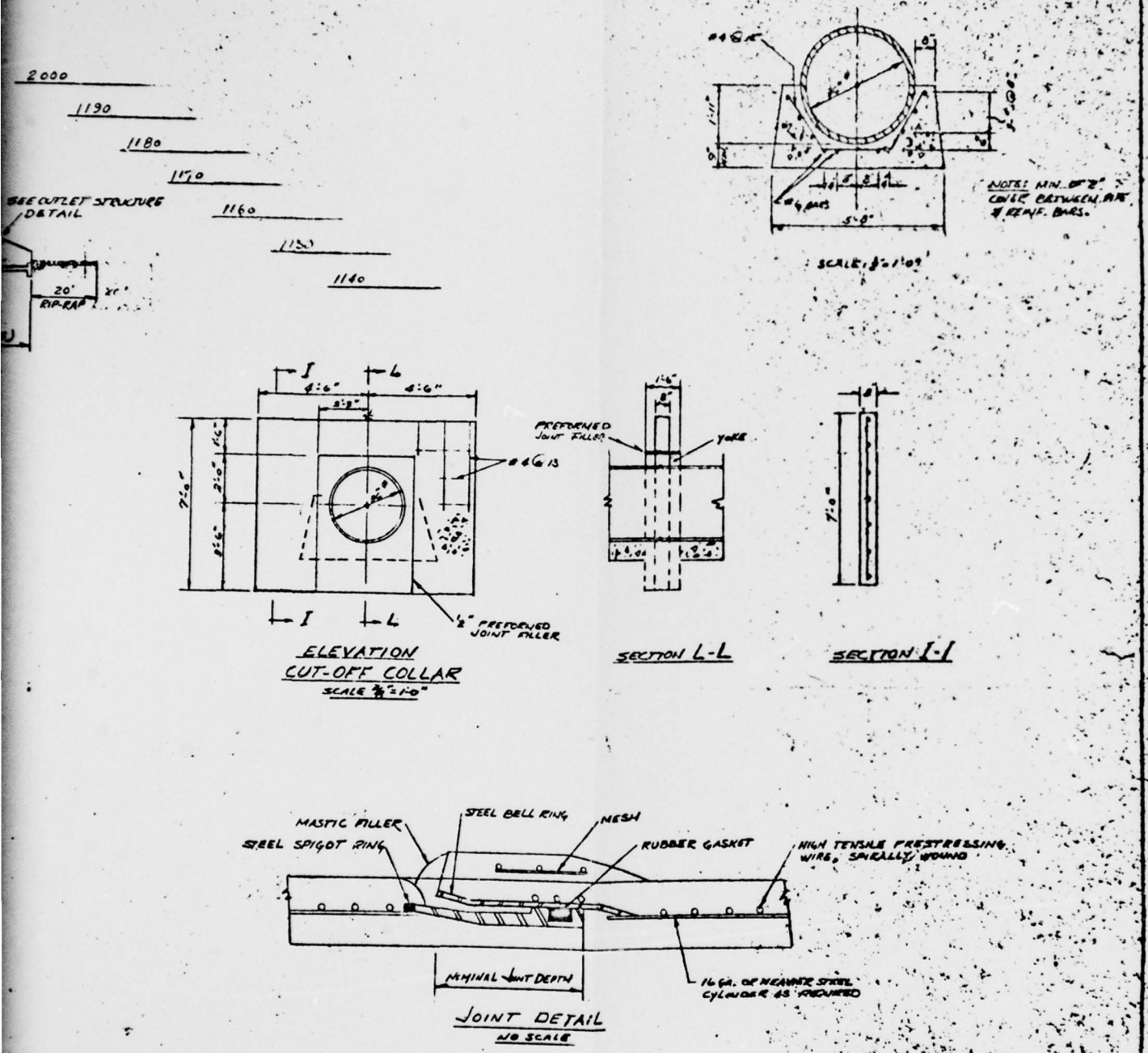
SCALE 3/8" = 1'-0"

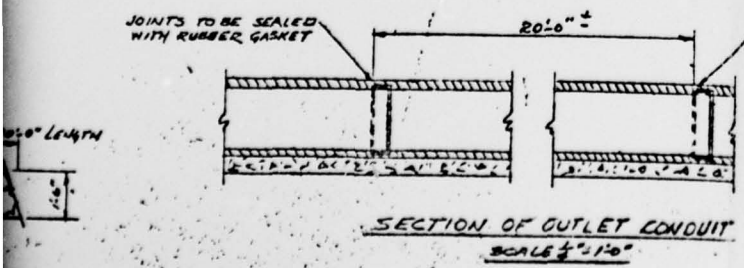


SECTION JJ

OUTLET STRUCTURE

SCALE 3/8" = 1'-0"





PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE SUSQUEHANNA DAM

HIGH VISTA, INC.

OUTLET WORKS DETAILS

AUGUST 1978 PLATE 8

1701

2

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL AND LUZERNE COUNTIES

PENNSYLVANIA

LAKE SUSQUEHANNA DAM

NDS ID No. PA-00818
DER ID No. 54-177

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Lake Susquehanna Dam

NDS ID NO.: PA-00818 DER ID NO.: 54-177

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	Complete set of construction drawings available.
REGIONAL VICINITY MAP	Project is not shown on USGS Maps. When updated, it will be shown on Conyngham, Pennsylvania Quadrangle Sheet N 4052.5 - W7600 /7.5
CONSTRUCTION HISTORY	Constructed in 1973 by High Vista, Inc.
TYPICAL SECTIONS OF DAM	Available.
OUTLETS: Plan Details Constraints Discharge Ratings	Plan and details available. No discharge ratings.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None.
DESIGN REPORTS	1972: Northeastern Engineering Company, Inc.; Includes soils investigation, embankment design, filter design, and compaction specifications. 1972: Permit application report by Penn DER.
GEOLOGY REPORTS	1972: Northeastern Engineering Company, Inc.; general and site geology.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	Final results of stability analyses and estimate of seepage; spillway designed for curve "C" discharge.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	Available.
POSTCONSTRUCTION SURVEYS OF DAM	None.

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	Within reservoir area.
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	8 - 12 inches over spillway in September 1975 flood.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	None.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	None.
SPILLWAY: Plan Sections Details	Available.
OPERATING EQUIPMENT: Plans Details	Available.
PREVIOUS INSPECTIONS Dates Deficiencies	None.

CHECKLIST

ENGINEERING DATA

HYDROLOGY AND HYDRAULICS

NAME OF DAM: Lake Susquehanna Dam NDS ID NO.: PA-00818 DER ID NO.: 54-177

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): Elevation 1190.0

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Elevation 1196.0

ELEVATION MAXIMUM DESIGN POOL: Elevation 1196.0

ELEVATION TOP DAM: Elevation 1196.0

SPILLWAY CREST:
- a. Elevation 1190.0
- b. Type Concrete ogee with chute.
- c. Width Not applicable.
- d. Length 45.0 feet.
- e. Location Spillover Left abutment.
- f. Number and Type of Gates None.

OUTLET WORKS:
- a. Type 36- inch RCP
- b. Location 600 feet from left abutment.
- c. Entrance Inverts Elevation 1146.00
- d. Exit Inverts Elevation 1144.96
- e. Emergency Draindown Facilities Same as outlet works.

HYDROMETEOROLOGICAL GAGES:
- a. Type None.
- b. Location None.
- c. Records None.

MAXIMUM NONDAMAGING DISCHARGE: Unknown.

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL AND LUZERNE COUNTIES

PENNSYLVANIA

LAKE SUSQUEHANNA DAM

NDS ID No. PA-00818
DER ID No. 54-177

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Lake Susquehanna Dam County: Schuylkill and Luzerne State: Pennsylvania

NDS ID No.: PA-00818 DER ID No.: 54-177

Type of Dam: Earth fill Hazard Category: High

Date(s) Inspection: 26-27 June 1978 Weather: Overcast Temperature: 80°

26 June - showers in afternoon; heavy rain in evening

27 June - overcast in morning; clear in afternoon

Pool Elevation at Time of Inspection: 1190.0 msl/Tailwater at Time of Inspection: 1140.0 msl

Inspection Personnel:

D. Wilson (GFCC)	N. Cunfer (High Vista)	
D. Wolf (GFCC)	J. DaGrosa (High Vista)	
D. Ebersole (GFCC)		

D. Wilson (GFCC) Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	1. Some minor sloughing and erosion on downstream slope.	1. Probably occurred before cover was established. Erosion repairs were made in 1976. Anti-erosion boards are still in place at mid-height across embankment.
CREST ALIGNMENT: Vertical Horizontal	1. Horizontal - no irregularities. 2. Vertical - crest elevation varies from El. 1195.4 to El. 1197.5 (Design elevation is El. 1196.0)	
RIPRAP FAILURES	1. Riprap intact and continuous on upstream slope to top dam. Small brush among riprap. 2. Crest - no cover. 3. Downstream Slope - 12" - 30" high crown vetch and clover.	1. Average riprap size 18 inches or larger; mostly sound conglomerate. 2. Crest is bare from vehicle traffic. 3. Some small areas not yet covered.

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	1. Right abutment - no abnormalities. 2. Spillway - low area on embankment is adjacent to spillway.	
ANY NOTICEABLE SEEPAGE	Swampy area at toe from 400 - 500 feet from right abutment. Slight standing water; no flow; not excessively soft.	Appears to be natural runoff concentration. Toe drain outlet also located here.
STAFF GAGE AND RECORDER	None.	
DRAINS	Three toe drain outlets: 1. 6-inch BCCMP about 400 feet from right abutment. 2. 8-inch BCCMP right side outlet structure. 3. 8-inch BCCMP left side outlet structure.	1. Had 10 gpm± clear flow. 2. Had slight trickle clear flow. Had 1-1/2-inch accumulation of sandy clay along its length. Also had about 1/2 C.Y. sand and fine gravel at outlet. 3. Dry; had about 1/2 C.Y. sand and fine gravel at outlet.

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None.	Conduit in good condition.
INTAKE STRUCTURE	Not visible (submerged).	
OUTLET STRUCTURE	Concrete in good condition except for some fine cracks extending outward from perimeter of outlet conduit blockout.	About 3 C.Y. of mud and sand in outlet structure. Conduit blockout has an expansion joint.
OUTLET CHANNEL	Lined with 12-inch riprap overgrown with crown vetch.	No apparent erosion.
EMERGENCY GATE	One gate at intake structure. Gate stand at top of dam. Stem in oil-filled casing. 3:1 reducer; 5 TPI; 2-inch stainless steel stem.	Gate stand was painted. Opened about 1/3 full easily. Owner operates gate every six months.

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Ogee type; excellent condition; no visible wear; joints sealed.	
APPROACH CHANNEL	Clear; no debris; no operating constraints.	Concrete approach walls excellent condition - no cracks; joints sealed.
DISCHARGE CHANNEL (Concrete Chute)	Concrete walls and slab excellent; no cracks, scaling or spalls; all joints sealed.	Drain holes in left wall of chute; all dry.
BRIDGE AND PIERS	None.	
DISCHARGE CHANNEL (Beyond Concrete Chute)	1V on 4H to outlet channel; riprap varies from 12-inch to derrick size. Discharge channel meets outlet channel at about 70° deflection angle.	Riprap placement not uniform; occasional gaps; ends at beginning of outlet channel. No apparent undue erosion.

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slopes about 1V on 8H; no signs of instability.	
SEDIMENTATION	No problem reported by Owner.	
WATERSHED DESCRIPTION	Owned entirely by High Vista, Inc.; all wooded; most of watershed will be developed.	High Vista, Inc., has restrictions on development so that trees may be removed only to construct house.
UPSTREAM DAMS	A breached, small dam is located upstream. (Lake Calumet)	High Vista, Inc., has tentative plans to rehabilitate this dam.

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	Access road crosses outlet channel about 70' downstream from dam. Has 6' diameter BCCMP culvert.	Would be overtopped and fail before tailwater would reach toe of embankment.
SLOPES	No apparent undue erosion.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Presently about 8 houses between dam and Catawissa Creek.	Lake Susquehanna Dam is upstream from Lake Choctaw Dam. Many houses are proposed to be in downstream area.
MISCELLANEOUS	Acid mine drainage enters channel from a tunnel outlet on the left hillside.	Tunnel opening about 3' high x 10' wide; about 100 - 200 gpm flow; abandoned V-notch weir located 10 feet from opening.

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL AND LUZERNE COUNTIES

PENNSYLVANIA

LAKE SUSQUEHANNA DAM

NDS ID No. PA-00818
DER ID No. 54-177

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

APPENDIX C

HYDROLOGY AND HYDRAULICS

Classification - ref. recommended guidelines

Hazard Potential - High, - since downstream population is 150

Size - Maximum height = 50 ft.
Storage = 200,000,000 gallons = 614 Acre-Ft.

∴ Intermediate Size P-D.8

Spillway Design Flood

The spillway design flood should be the PMF since the downstream hazard potential is high and the size is intermediate according to Table 3 of Recommended Guidelines for Safety Inspection of Dams.

Analysis of Spillway

reference - Phase 1 procedure package, NAB

II.A. Susquehanna Lake Dam is ideally situated. The upstream dam constructed by the developer (Lake Calumet) has been breached and there are no impoundments upstream of Susquehanna Lake

2. The PMF inflow hydrograph is not available

a. As per contact with NAB, Susquehanna River Basin, Region 2 curve is to be used for the PMF peak, and Vol = 24" of runoff

$$PMF\ peak = 2690 \frac{cfs}{Mi^2} \times 1.89\ Mi^2 = 5084\ cfs$$

say 5080 cfs

$$Vol = 2' \times 1.89\ Mi^2 \times 640 \frac{Acres}{Mi^2} = 2419\ Ac\text{-}Ft \times \frac{43560}{3,600} = 29,272\ cfs\text{-}hr$$

$$b = 29,272 \times \left(\frac{2}{5080}\right) = 11.52\ hrs$$

$$Vol\ @\ \tfrac{1}{2}\ PMF\ peak = 2540 \times \frac{11.52}{2} = 14,630\ cfs\text{-}hrs = 1209\ Acre\text{-}Ft$$

B. Ability of Spillway to pass PMF.

1. Spillway Capacity Estimate

Length - 45'

H = 6' (1196.0 Top of dam - 1190.00 weir crest)

Ogee Section

from "Design of Small Dams" - p 377

$3.3' = X_5 = 0.880\ H_o \rightarrow \quad H_o = 3.75$

$10.5' = R_5 = 2.8\ H_o \rightarrow \quad H_o = 3.75$

$.58' = X_4 = 0.154\ H_o \rightarrow \quad H_o = 3.77$

$5.29 = R_4 = 1.410\ H_o \rightarrow \quad H_o = 3.75$

$1.99 = R_2 = 0.530\ H_o \rightarrow \quad H_o = 3.75$

$0.88 = R_1 = 0.235\ H_o \rightarrow \quad H_o = 3.74$

∴ Assume that the design head = 3.75'

and

$$Q = 3.87 \cdot 45' \cdot (3.75)^{3/2} = 1265 \text{ cfs}$$

↳ at $P/H_o = 3.09/3.75'$ p 378

@ 6' of head

$\frac{C}{C_o} = 1.07$ @ $\frac{H_e}{H_o} = \frac{6}{3.75'} = 1.60$ p 378

$$Q = 1.07 \times 3.87 \times 45' \times (6)^{3/2} = \underline{\underline{2738 \text{ cfs}}}$$

@ 5.4' of head

$\frac{C}{C_o} = 1.05$ @ $\frac{H_e}{H_o} = \frac{5.4}{3.75} = 1.44$ p 378

$$Q = 1.05 \times 3.87 \times 45' \times (5.4)^{3/2} = 2294$$

2. The PMF peak flow is greater than the spillway capacity (5080 > 2294)

b. The routing of the PMF is unavailable

(1) Percent of the PMF which is capable of passing the spillway.

$$P = \frac{\text{spillway capacity}}{\text{PMF Peak}} \times 100 = 45.2\%$$

(2) Estimate the storage effect of the reservoir (Reference : Inclosure 3)

$\Delta AOC = (1 - P)\Delta AOB$

$= (1 - 0.452) \times 2419 = 1326$ Acre-Ft

Assume that a right circular cone with 8H on 1V side slopes will adequately model the reservoir.

$A = 44$ Acres $= \pi r^2 \therefore 781.08 = r$

$\Delta r = 8 \cdot \Delta V = 8 \times 5.4 = 43.20$

$r_2 = 824.28$

At Elev. 1195.4

$A_2 = \pi \times \frac{824.28^2}{43560} = 49$ Acres

$\therefore$ Estimated Surcharge Storage

$= \left(\frac{44+49}{2}\right) \times 5.4 = 251.1$ Acre-Ft.

Surcharge Storage required is greater than the storage available.

C.2.a. Adequacy of Spillway

ETL 1110-2- States that three conditions must exist before spillway capacity is considered to be seriously inadequate.

b. Check condition "C" - Ability of spillway to pass ½ PMF without overtopping.

½ PMF = 5080 ÷ 2 = 2540 > 2294

$P = 2294/2540 = 0.903$

$\Delta AOC = (1 - 0.903) \times 1209 = 117.3$ Acre-ft.

$\therefore$ Storage Available is sufficient to contain the ½ PMF and the dam is not seriously inadequate

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Susquehanna Lake Dam FILE NO. 7613.4A
Hydrology and Hydraulics SHEET NO. 4 OF 5 SHEET
FOR USCE - Baltimore
COMPUTED BY DAW DATE 7-78 CHECKED BY FFM DATE 7-78

% of PMF which can pass Lake Susquehanna.

$$\% = \frac{2294 + \frac{2 \times 251.1 \times 43560}{11.52 \times 3600}}{5080} = 55.5\% \text{ or } 2820 \text{ cfs}$$

with top of dam at El. 1195.4

if top of dam is brought up to El. 1196.0

$$\% = \frac{2738 + \frac{2 \times 280.7 \times 43560}{11.52 \times 3600}}{5080} = 65.5\% \text{ or } 3330 \text{ cfs}$$

SP 11860A

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Lake Susquehanna Dam FILE NO.
Hydrology and Hydraulics SHEET NO. 5 OF 5 SHEETS
FOR USCE - Baltimore
COMPUTED BY DAW DATE 7-78 CHECKED BY FFM DATE 7-78

Tailwater Elev. @ Spillway Capacity

a. Tailwater Depth = 4.1 ft. HEC-2 computer run
b. Top of Dam Elev = 1195.4 GFC&C Survey
c. Channel @ Outlet conduit = 1139.0 "
d. Tailwater Elev. = 1143.1
e. $\Delta H = b - d = 52.30$ ft.

SP 11860A

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL AND LUZERNE COUNTIES

PENNSYLVANIA

LAKE SUSQUEHANNA DAM

NDS ID No. PA-00818
DER ID No. 54-177

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

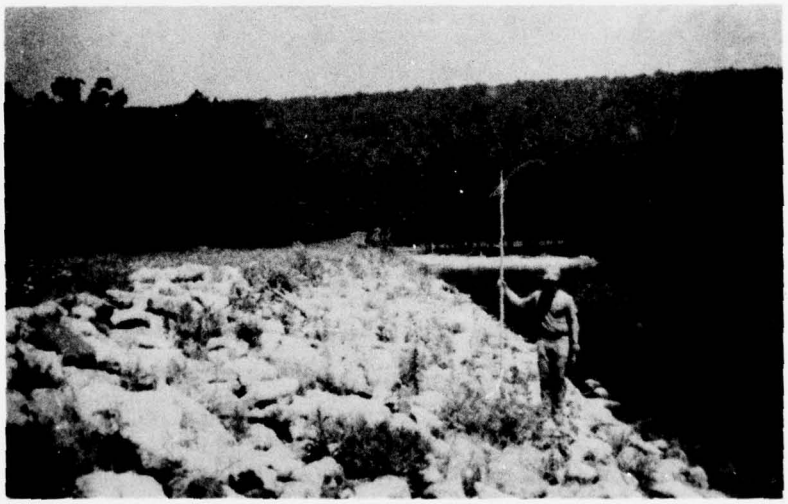
AUGUST 1978

APPENDIX D

PHOTOGRAPHS

LAKE SUSQUEHANNA DAM

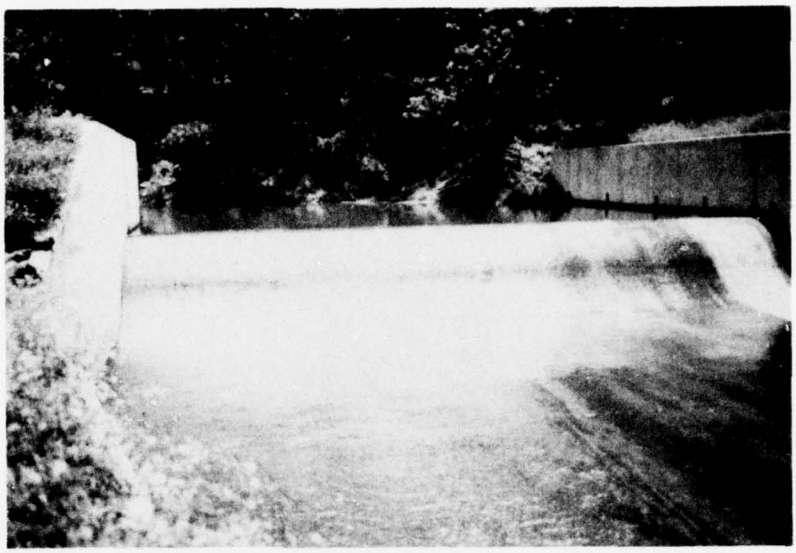
A. Embankment — View from Right Abutment.



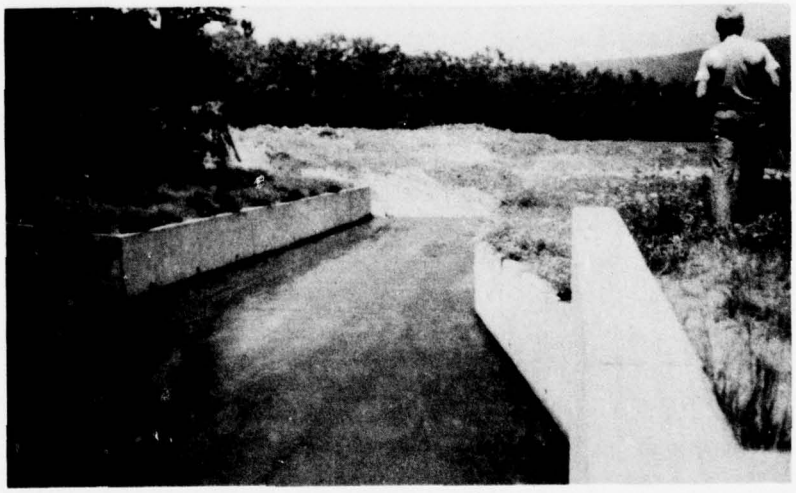
B. Riprap on Upstream Slope
Near Center of Embankment.

C. Downstream Slope of Embankment —
View from Left Abutment.

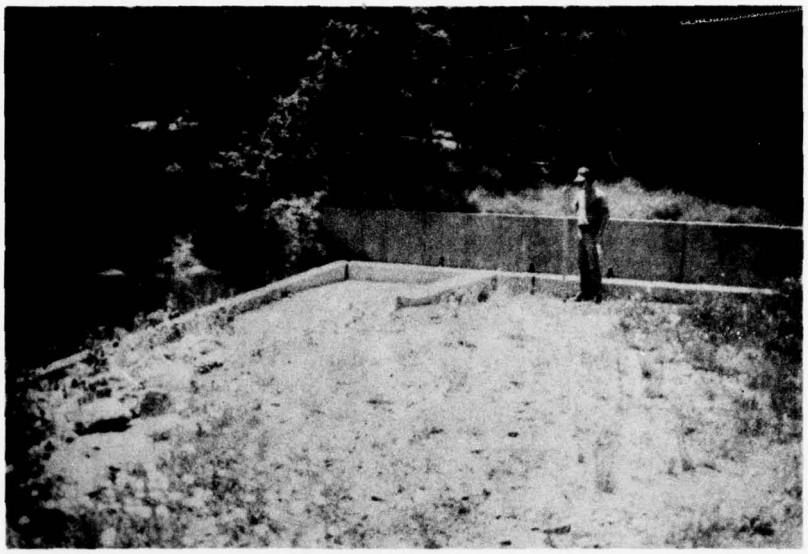
D. Sloughed Area on Downstream Slope
Near Spillway.



E. Spillway Approach Channel and Spillway Crest.



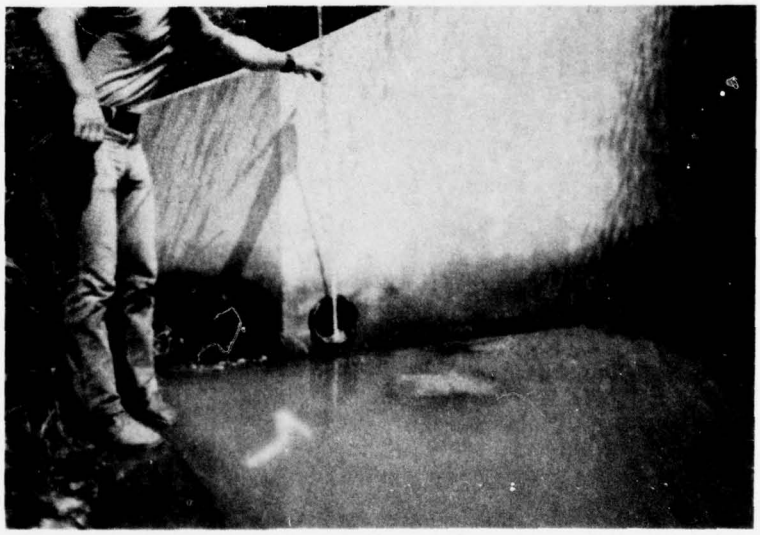
F. Concrete Spillway Chute.



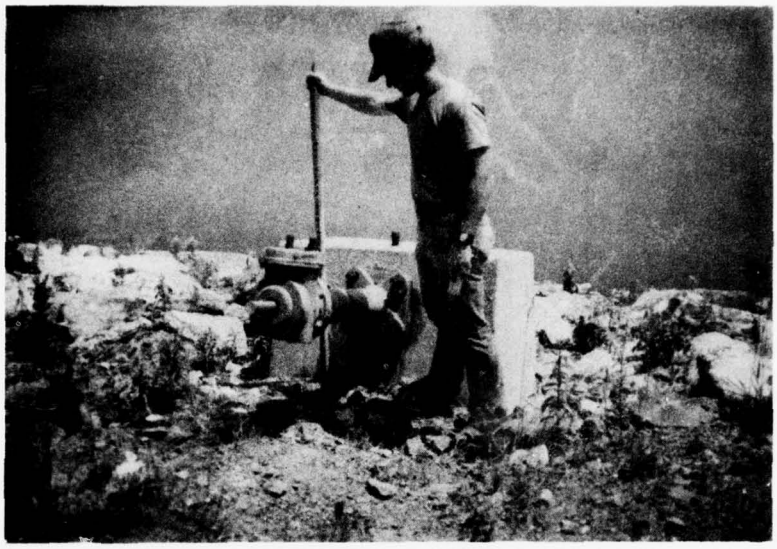
G. Low Area on Embankment at Spillway.

H. Concrete Chute Spillway and
Spillway Discharge Channel.

J. 6-Inch Toe Drain Outlet
400 Feet from Right Abutment.

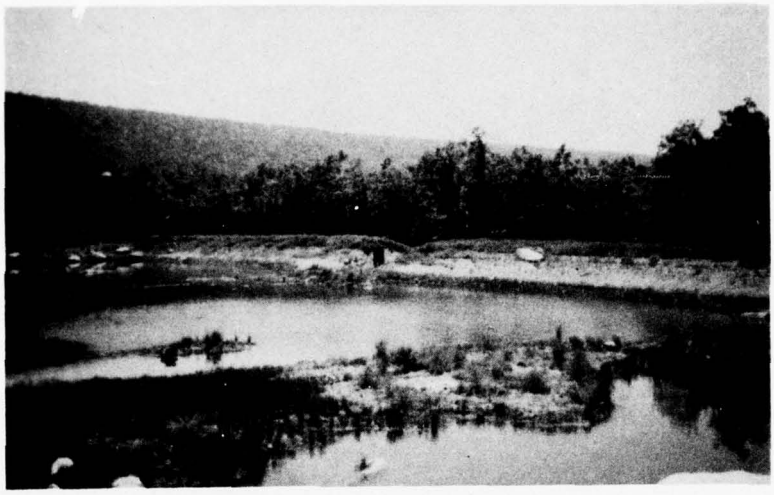


K. 8-Inch Toe Drain Outlet at
Outlet Works Outlet Structure.

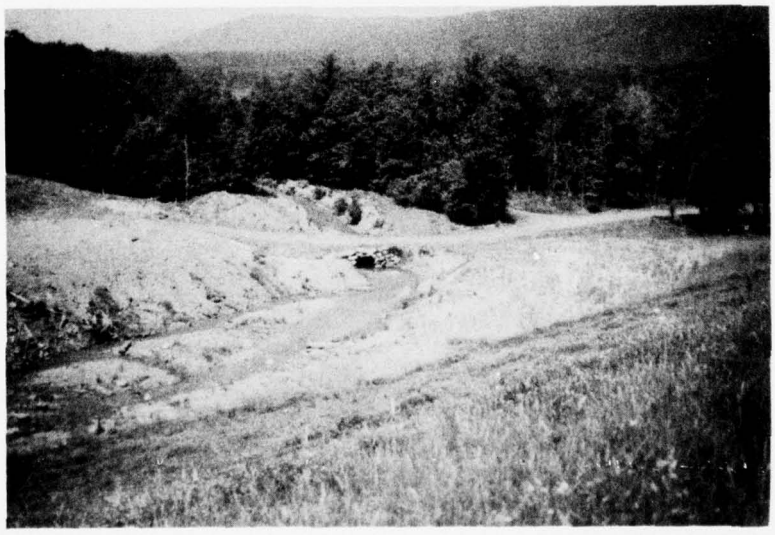


L. Gate Stand on Top of Dam.

M. Outlet Works During Operation of Slide Gate.



N. Lake Calumet Dam Located Upstream from Lake Susquehanna Dam. Breached Area of Embankment is at Center.



O. Downstream Channel Area.

SUSQUEHANNA RIVER BASIN

LITTLE SUGARLOAF CREEK, SCHUYLKILL AND LUZERNE COUNTIES

PENNSYLVANIA

LAKE SUSQUEHANNA DAM

NDS ID No. PA-00818
DER ID No. 54-177

HIGH VISTA, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1978

APPENDIX E

GEOLOGY

LAKE SUSQUEHANNA DAM

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located on the border between Luzerne and Schuylkill Counties. The rock formations exposed in Luzerne County range from the post-Pottsville formations of Pennsylvania Age, down to the Onondaga formation, of Middle Devonian Age. In Schuylkill County, the exposed rock formations range from the post-Pottsville to Onondaga formations of Luzerne County down to Tuscarora sandstone of Silurian Age in the southern part of the county. The Wisconsin terminal moraine which covered the greater part of Luzerne County with glacial drift, terminates slightly north of this border area. Otherwise, the geology of this border area is more closely related to the geology of Luzerne County than it is to Schuylkill County.

Nearly all of Luzerne County lies in the Valley and Ridge Province in which nearly all the rocks have been strongly folded. In going from north to south across the County, five major folds are encountered, all of which trend northeast. The first of these is a shallow syncline on the crest of North Mountain, forming the Mehoopany coal basin. The second is the Milton Anticline, which exposes the Portage group in the northwestern part of the County and gradually flattens out toward the northeast. The third and most pronounced is the Lackawanna Syncline, which originates in Lackawanna County to the north, and has preserved the post-Pottsville formations throughout the Wyoming Valley. The maximum depth of this syncline is reached in the vicinity of Wilkes-Barre and Plymouth. The double rim of this syncline is formed by the resistant Pottsville formations and Pocono sandstone, separated by the less resistant Mauch Chunk shale. The fourth fold is the Berwick (Montour) Anticline, which exposes a few feet on the Onondaga formation in the vicinity of Beach Haven. This fold reaches its maximum development farther west and only the eastern portion reaches Luzerne County. The fifth

major fold comprises a series of anticlines and synclines forming the Eastern Middle Anthracite Field in the vicinity of Hazelton. The synclinal basins in this region are relatively shallow and there are large areas from which all coalbeds have been eroded.

The general dips of the region vary from 0^{o} to 40^{0}, and the maximum dips are found on the rims and within the synclinal coal basins. The relatively soft post-Pottsville beds in their cores are severely folded and contorted with numerous minor faults. The northern and easternmost parts of the County border the Appalachian Plateau Province and are characterized by horizontal, or nearly horizontal strata. The Catskill continental group of rocks underlies those parts of Luzerne County that are outside of the five major folds.

2. Site Geology. The project area is located on the western edge of the Eastern Middle Anthracite Field. The dam site itself is underlain by the Mauch Chunk red shale formation which will form the abutments at both ends of the dam. The bedrock is overlain by a soil blanket that varies from 20 to 45 feet in depth, with the deeper soils located in the center of the valley. The decomposed shale topsoil consists generally of stratified layers of clayey sand (SC), clayey gravel (GM), sandy clay (CL) and sandy silt (ML), with the last named generally located adjacent to the bedrock. The Pottsville formation with mineable coal is found downstream, or south, of the dam site. A mine drainage tunnel discharges into the stream immediately downstream of the dam.